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Thermal Exposure of Ammunition On Board Ship

Part 3. Ammunition Ships

by
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JUNE 1981

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CHINA LAKE, CALIFORNIA 93555

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FOREWORD

This report presents results of an investigation to determine the valid shipboard thermal environment of ammunition. The work was conducted by the Naval Weapons Center (NWC), China Lake, California, and supported by the Naval Air Systems Command under AirTask A03W-3300/008B/F31300000.

This report, Part 3, covers the probable thermal exposure to be found on cargo type ships. The previously published volumes, Part 1 and Part 2, cover cruisers/large destroyers and aircraft carriers, respectively.

This report has been reviewed for technical accuracy by J. P. Jones.

Approved by
R. V. BOYD, *Head*
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15 June 1981

Under authority of
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(U) The magazine air temperature records from general cargo and logistic support type ships have been statistically analyzed to obtain the probable thermal exposure to be found on these type ships. The information is divided into the temperature expectancies for the various deck levels as applicable. Effort has been made to eliminate information from compartments influenced by the engine room. This report includes more than 400,000 data points from 24 ships. The ships were assigned to the 1st, 2nd, 6th and 7th Fleets in the time frame of 1958 through 1973.

CONTENTS

INTRODUCTION

An important factor in designing a ship-launched weapon is the environmental temperature range the weapon will experience during storage and transportation. As part of a larger program aimed at determining the stockpile-to-target environments that will be experienced by air-launched weapons, a study was undertaken to define the thermal regime as it pertains to shipboard storage.

Recording of the maximum and minimum air temperatures in each magazine on board every ship in all fleets has been required for years. This requirement, however, was strictly for safety; the records were usually retained on board the ship for only 1 to 2 years and then destroyed. At the request of the Naval Weapons Center (NWC), the Chief of Naval Operations in 1967 instructed all Fleet elements to send their obsolete magazine records to NWC for use in this project. Ships from all numbered fleets, including the 6th and 7th Fleets, responded to this request; the information from frigates and aircraft carriers was reported in Parts 1 and 2 of this report series.

This volume, Part 3, presents the data and results as they pertain to cargo and logistic type ships. Eventually all ship classes may be divided into logical study units and similar reports detailing the storage temperatures for each group prepared and published as the need is expressed.

More than 400,000 maximum or minimum temperature data points collected from all types of compartments and lockers on all levels of cargo ships have been integrated into this report. (This represents over 200,000 ship magazine days of measurement.) The data collection time frame for each ship ranged from a few months to years. Many of these ships are no longer in service; however, the data are considered valid since all ammunition compartment temperatures tend to describe a very narrow band of exposure. Also, it was thought these obsolete ships data would detail any thermal differences that would exist in future supply ship design, if such tend to exist.

A complete definition of the extreme temperature circumstances is not provided since the exact day-by-day position of the ship is not known. Therefore, it is possible that in spite of the mass of data presented a chance of exposure to less moderate temperatures could be experienced. Also, there was no control over ship deployment or of the personnel actually recording the individual temperature readings. The sources of error in the existing collection system, however, have been investigated and compensation was made. For example, the measuring instrument, a "horseshoe" thermometer equipped with maximum and minimum temperature tattletales, could be affected by ship vibration. If mounted on a resonating bulkhead, the vibration could shake the tattletales down to the menisci of the mercury. This is evidenced in the records by identical maximum and minimum temperature entries for an interval of several days.

The lack of ship location information for a given day does not invalidate the data obtained since a correlation was made during the investigation on the service temperature of the antisubmarine rocket (ASROC) missile.[1,2] In this correlation, the recorded sea water temperature was compared with the minimum recorded ASROC motor temperature for the same day. The resulting readings were within a few degrees of each other. Since the data were from ships[1,2] assigned to the 7th Fleet, and this Fleet's area of interest is the Western Pacific, given the month and minimum compartment temperatures, a good guess can be made as to where the ship was located. As indicated in footnotes 1 and 2, the Western Pacific could be the warmest area in which our ships will be required to be deployed. When considering the cold-extreme situations, there is a logically self-limiting factor. For instance none of the ships providing data were in the Beaufort Sea during winter. This sea is ice choked in winter and a ship would quite possibly be stuck in the ice until the next summer.

During the data accrual period, the candidate ships were deployed between 9° and 20° north latitude in the South China Sea. Thus these data, though incomplete and imperfect, are of extreme value in determining the environmental temperature criteria to which a majority of ship-launched ordnance will be exposed. This work then lays a foundation for determining the ammunition ship's maximum and minimum temperature regime for any nonheat generating naval material so as to be in design compliance with DOD Directive series 4120 and 5000. In addition, these data are indicative of the "ship transported" thermal regime of all ordnance and military material.

As stated above, the data presented herein do not permit the exact correlation of ship location at the time a given temperature was recorded. However, these data indicate that ships herein included were underway in the North Atlantic during January, and in the West Pacific during the tropical hot season. These ships operate both independently and within an aircraft carrier task force. Therefore, it is safe to assume that more severe ammunition exposure during this event of the factory-to-target sequence will be nonexistent to rare. Based on these considerations it

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[1]Naval Weapons Center. *Launcher Environment of the ASROC Motor. Part 1. Motor Wall Temperature,* by C.A. Taylor and H.C. Schafer. China Lake, Calif., NWC, June 1967. (NWC TP 4349, Part 1, publication UNCLASSIFIED.)

[2]-----. *Launcher Environment of the ASROC Motor. Part 2. Deck Magazine Temperatures,* by C.A. Taylor and H.C. Schafer. China Lake, Calif., NWC, November 1969. (NWC TP 4349, Part 2, publication UNCLASSIFIED.)

can be stated that the probable chance of occurrence of the ordnance and material response temperature is as herein displayed.

INSTRUMENTATION

The horseshoe-type mercury thermometer (Figure 1) was used to obtain the data. This type thermometer, equipped with a floating steel tattletale device, allows maximum and minimum temperatures to be recorded. The tattletale device rests on the menisci of the mercury and moves only in the upward direction. When a meniscus moves in the downward direction it leaves the tattletale at the departure point, thus indicating the maximum or minimum temperature for the measurement period. Using a magnet, the tattletales are reset to rest on the menisci after recording the maximum and minimum temperatures. These thermometers are generally mounted on the bulkhead of the ship or laid on top of the ordnance within the locker.

The thermometer manufacturers (Taylor, Weksler and Moeller) warrant that the temperature readings are accurate to within 2°F at the time of delivery.

DATA HANDLING

The raw data were received from the many ships in various forms, i.e., temperature logbooks, individual monthly magazine temperature record cards or individual temperature record sheets gathered together in an envelope. These records identified the month, day and year the temperatures were recorded as well as the magazine or compartment of data origin.

These raw data were keypunched, reduced, tabulated and plotted to yield meaningful statistics and significant points of interest for upper and lower deck levels of various ships types and groups of similar ships. (Appendix A details the processing of the raw data.) The upper deck level was defined as the second deck and above; the lower deck level was the third deck and below. This division of levels took into account the temperature data from above and below the waterline and their possible effects. Appendix B provides an explanation of the deck level and compartment identifications.

RESULTS AND CONCLUSIONS

During this investigation, 411,949 data points were collected on the ships covered in this report. These data represent a composite of the 15 years from 1958 through 1973. The types of ships providing these data can be arbitrarily divided into two groups according to hull design and characteristics: medium to large cargo type ships, and special purpose ships. The few small or special purpose ships data are included to indicate the similarity of thermal response of the whole. The following discussions of the specific ship classes and the "logistic" fleet in general bear out that the thermal environment aboard such craft is truly moderate.

Though the data presented herein make it highly obvious, it must be stated that the old design values of -65° and 160°F were never experienced. Temperatures of these magnitudes simply are not in evidence on-board any logistic ship. This fact was previously recognized in Parts 1 and 2 of this report series as related to cruisers, guided missile frigates, and aircraft carriers.

CLASSIFICATION

The grouping of ships for publication in this report is somewhat arbitrary. A quick look at the picture of each candidate ship will show that they all appear, to the uninformed layman, to be cargo ships, with the exception of a small mine sweeper, an amphibious transport dock ship, and a very special purpose ship converted from an old antisubmarine warfare (ASW) "Jeep" carrier. These last three ships were included partially because they do not conform to any other part of this report series, and their data indicate that the magazine temperature is more a function of the temperature of the sea than the size of the ship. Therefore, all the ships herein reported will be viewed as one ship class. However, to a true sailor this is blasphemy. So, in general, the major classifications of ships consist of ammunition ships, destroyer tenders, repair ships, submarine tenders, and the three aforementioned miscellaneous ships; the CC-2, LPD-2 and MSC-198. To be more specific in the identification of the candidate ships, Table 1 is presented.

LOGISTIC SHIP FLEET

The ships that provided magazine temperature data are listed in Table 1. Figures 2 through 25 indicate the differences in structure and size of these representative U.S. Navy cargo duty ships both past and present.

TABLE 1. Data Ships.

Ship	Hull no.	Data years	Figure
U.S.S. Wrangell	AE-12	1962-1969	2
U.S.S. Paricutin	AE-18	1965-1970	3
U.S.S. Diamond Head	AE-19	1967-1970	4
U.S.S. Pyro	AE-24	1963-1965 1969-1971	5
U.S.S. Virgo	AE-30	1966-1967	6
U.S.S. Cascade	AD-16	1966-1973	7
U.S.S. Sierra	AD-18	1966-1973	8
U.S.S. Yosemite	AD-19	1966	9
U.S.S. Arcadia	AD-23	1966-1968	10
U.S.S. Frontier	AD-25	1967-1968	11
U.S.S. Yellowstone	AD-27	1966-1970	12
U.S.S. Grand Canyon	AD-28	1964-1972	13
U.S.S. Isle Royale	AD-29	1962-1966	14
U.S.S. Tidewater	AD-31	1965-1968	15
U.S.S. Bryce Canyon	AD-36	1963-1967	16
U.S.S. Ajax	AR-6	1958-1966	17
U.S.S. Jason	AR-8	1962-1967	18
U.S.S. Klondike	AR-22	1959-1963	19
U.S.S. Howard W. Gilmore	AS-16	1965-1967	20
U.S.S. Arion	AS-18	1965-1966	21
U.S.S. Proteus	AS-19	1963-1966	22
U.S.S. Wright	CC-2	1967-1969	23
U.S.S. Vancouver	LPD-2	1963-1966	24
U.S.S. Peacock	MSC-198	1962-1966	25

An attempt was made to consolidate all the data from these ships. Since the data were so similar, it was thought that the data from these ships might conveniently group to provide a truly universal display of magazine temperature data for any given level in a cargo ship operating in U.S. Navy Fleets or oceans of the world. Note that at no time during the 15 calendar years of this data accumulation effort was any ship tasked to sail to a given area specifically for this project. Rather, it can be assumed that sailing orders for any ship were typical of that particular fleet's mission during that period. Therefore, it seems logical that a random use population of mission induced magazine temperature information was indeed derived.

Since the data are so similar it was decided by the authors to present a detailed display of level-by-level results for only one ship type. Also, since the title for this report is *Ammunition Ships*, the AE seemed the logical ship type for a detailed display.

Figures 26-29 are the displays of data from a composite of the above the main deck levels of all the reporting AE type ships. Notice that their temperature extreme end points are all about the same. Also, that there is a difference in curve shape and mean point. This can be explained by the fact that these upper deck lockers are of the same type and construction as shown in Figure 1. Also, the thermometer is not located in a fixed position, but depends on the locker load for position with respect to the top and sides of the metal lockers.

In comparison, the data display of Figures 30-35 are all much more regimented. Notice that the below decks holds of ammunition ships are much more moderated. This is because the below deck temperature regime is forced by the temperature of the ocean water in which the hull floats. It is of interest to note in Figures 26-29 that a lower locker temperature of 18°F was experienced during small portions of a three day span on one ammunition ship on the North Atlantic run during winter. Also, notice in Figures 30-35 that this same low temperature value does not show up at all. The ocean is one big heat sink. The ocean also turns solid at 27°F. Therefore, a ship afloat, being thermally (and physically) small, will at the most extreme only follow the thermal regime of the water in which it floats. However, the air above the water is the thermal matrix in which the ready-service, or above deck pyrotechnic lockers are immersed. It is very believable that these lockers would experience lower temperatures than the holds of the ship. It is interesting that the reported temperature low of 18°F was only experienced by one ship in the period of record since many ships in this sample traveled the same sea lanes. The conclusion can be made that even in the North Atlantic in winter the chance of these extreme temperatures being experienced by the cargo is exceedingly small.

Figures 36 and 37 are the statistical sum of Figures 26-29 and 30-35. Figure 38 is the complete data display for all compartments of the AE ships reporting from all numbered fleets. Here it is very evident that the thermal regime of the ammunition ship is indeed benign.

Figures 39-44 indicate that all cargo ships can be grouped into a common category and that they respond the same thermally as the AE type ammunition ship. During the preparation of this report, these figures were all placed on a light table; very few differences were apparent. Figure 44 is in reality the bottom line on the thermal response of cargo during ship transportation. Notice that its end points are very divergent when compared with individual figures. Also notice the shallow slope of the asymptotic approach to these end points. All this indicates is that there were not very many data points out of the 411,949 reported herein. This figure really indicates that about 80% of all these data are grouped between 55° and 85°F.

Figure 44 provides a total accumulation of all ships composite data. This figure can be used, for all intents and purposes, as the thermal criterion for storage of ordnance munitions and material on board ships.

In Figure 44 the curve shape is very symmetrical. The symmetry is very similar to that of a Gaussian distribution. Because a Gaussian display more easily portrays the "extreme" or end point data, while fully portraying the central portion of the data population, an attempt was made to place Figure 44 in Gaussian format. Figure 45 is a replot of Figure 44 data on Gaussian paper. The prime use of Figure 45 is to derive a quantification for even more "extreme" data than were measured during this project. Because there is no end point to a Gaussian distribution, the straight line of Figure 45 can be extended out to infinity if desired. By the statistical laws governing the Gaussian distribution, the probability of occurrence for any chosen temperature can be derived from the extension of the plot of Figure 45. However, moderation in all things should be the watchword. Remember that the area under a Gaussian curve between $\pm 3\sigma$ is 99.7% of the total population.

SUMMARY AND CONCLUSIONS

The temperature data derived from above and below deck storage compartments of cargo type ships are very moderate. Nowhere in any of these data was a temperature value of -65° or 160°F even remotely approached. It would seem more prudent, if a set of shipboard temperature limits must be specified, to use the Figure 45 displayed 3σ values of +38° and +88°F, or rounding these values off, 40° to 90°F.

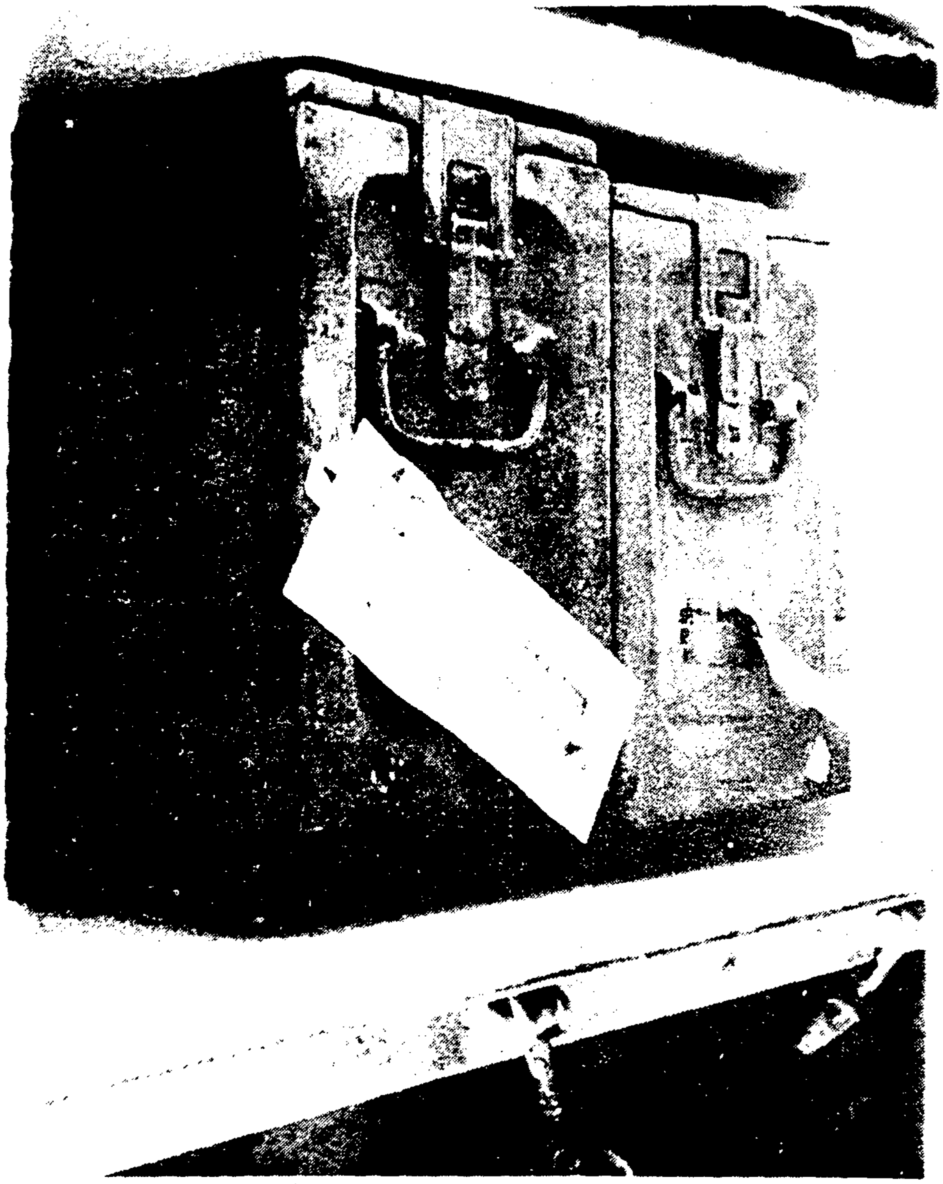

FIGURE 1. Horseshoe Thermometer.

FIGURE 2. U.S.S. Wrangell.

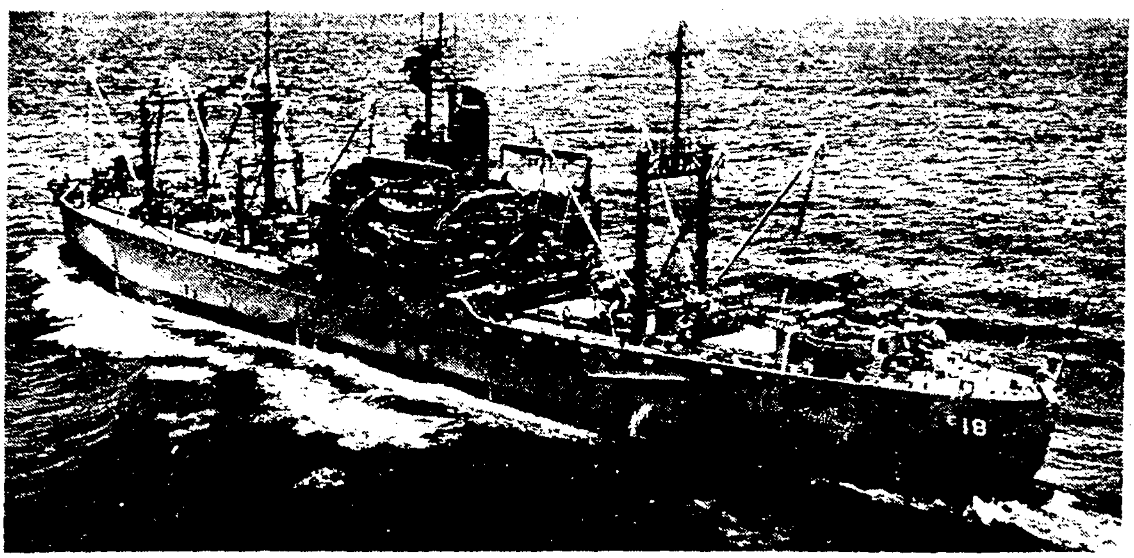

FIGURE 3. U.S.S. Paricutin.

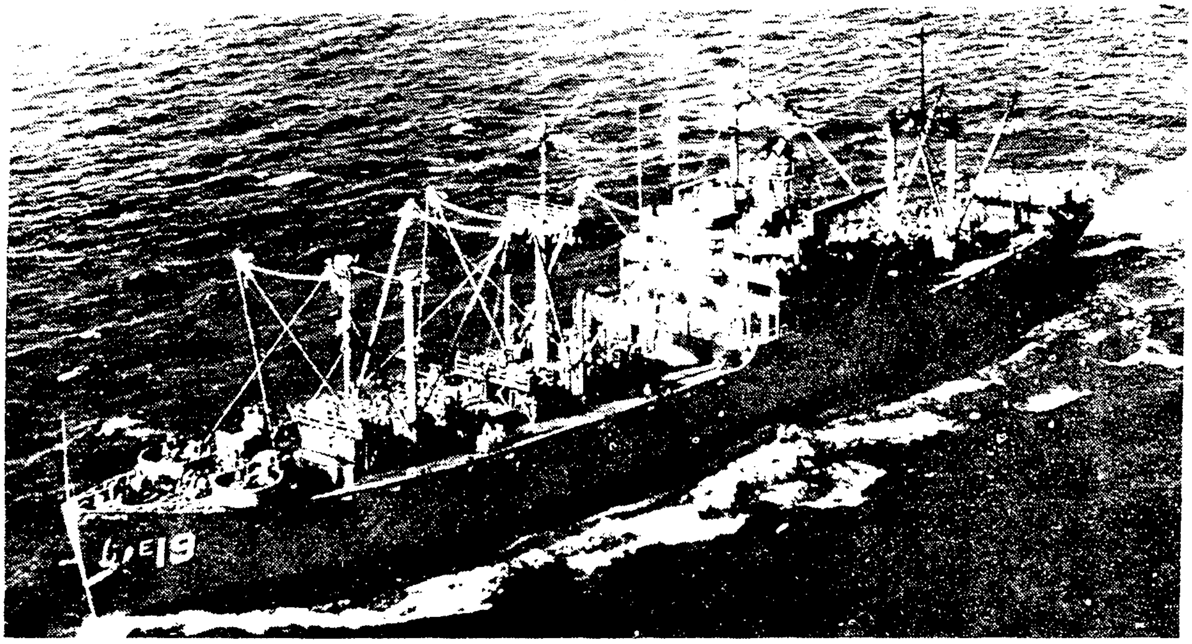

FIGURE 4. U.S.S. Diamond Head.

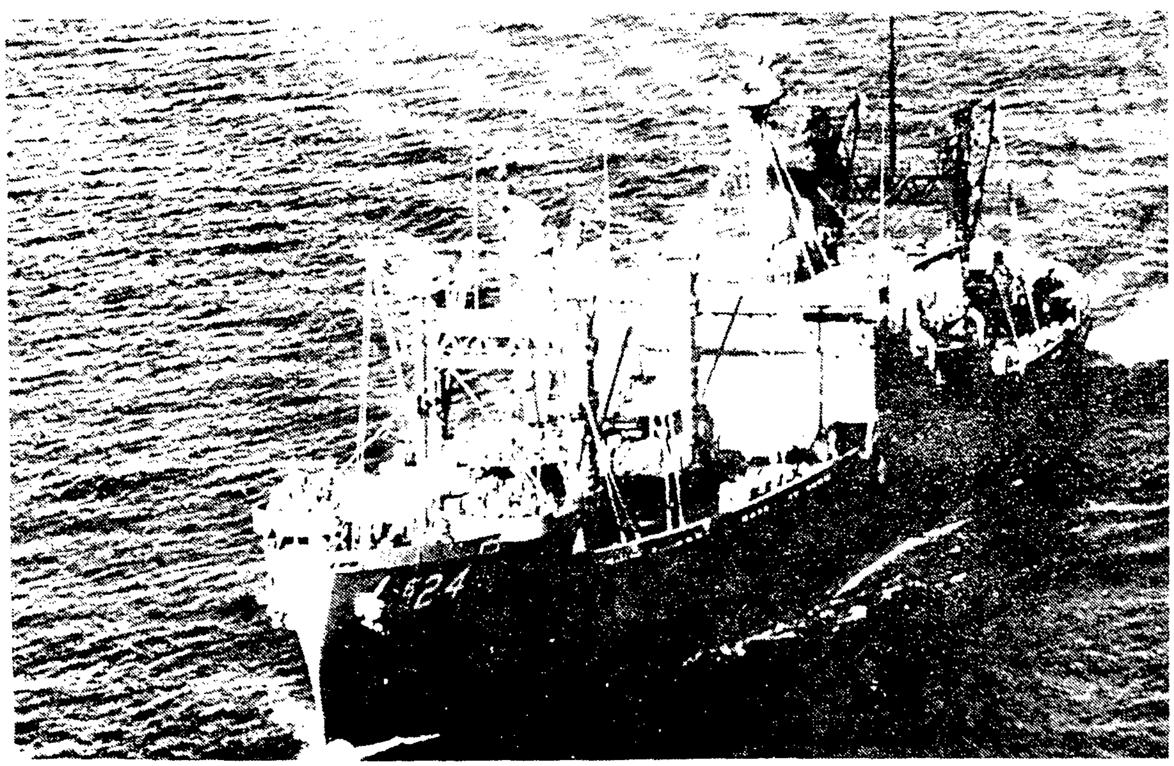

FIGURE 5. U.S.S. Pyro.

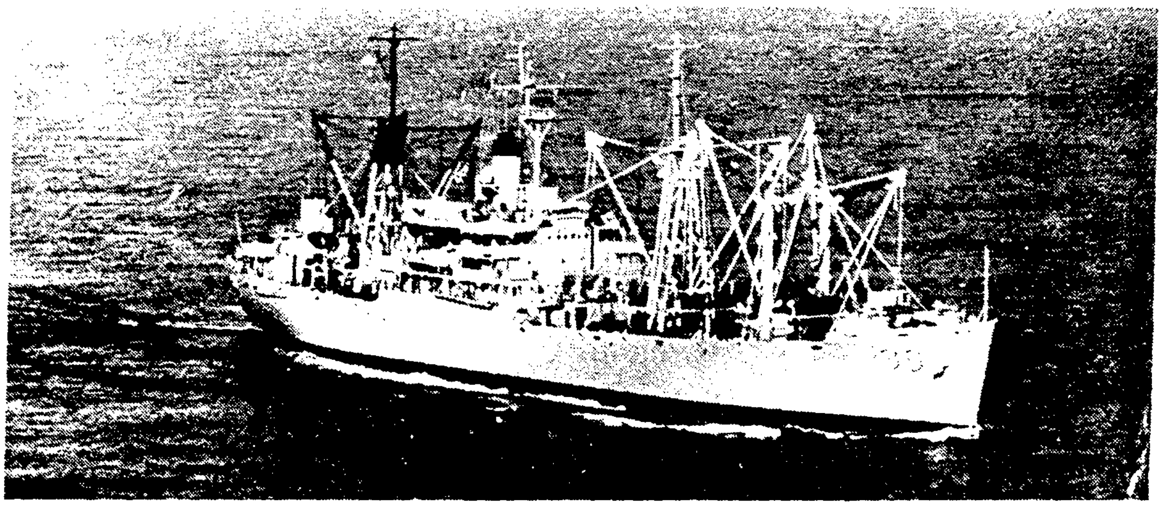

FIGURE 6. U.S.S. Virgo.

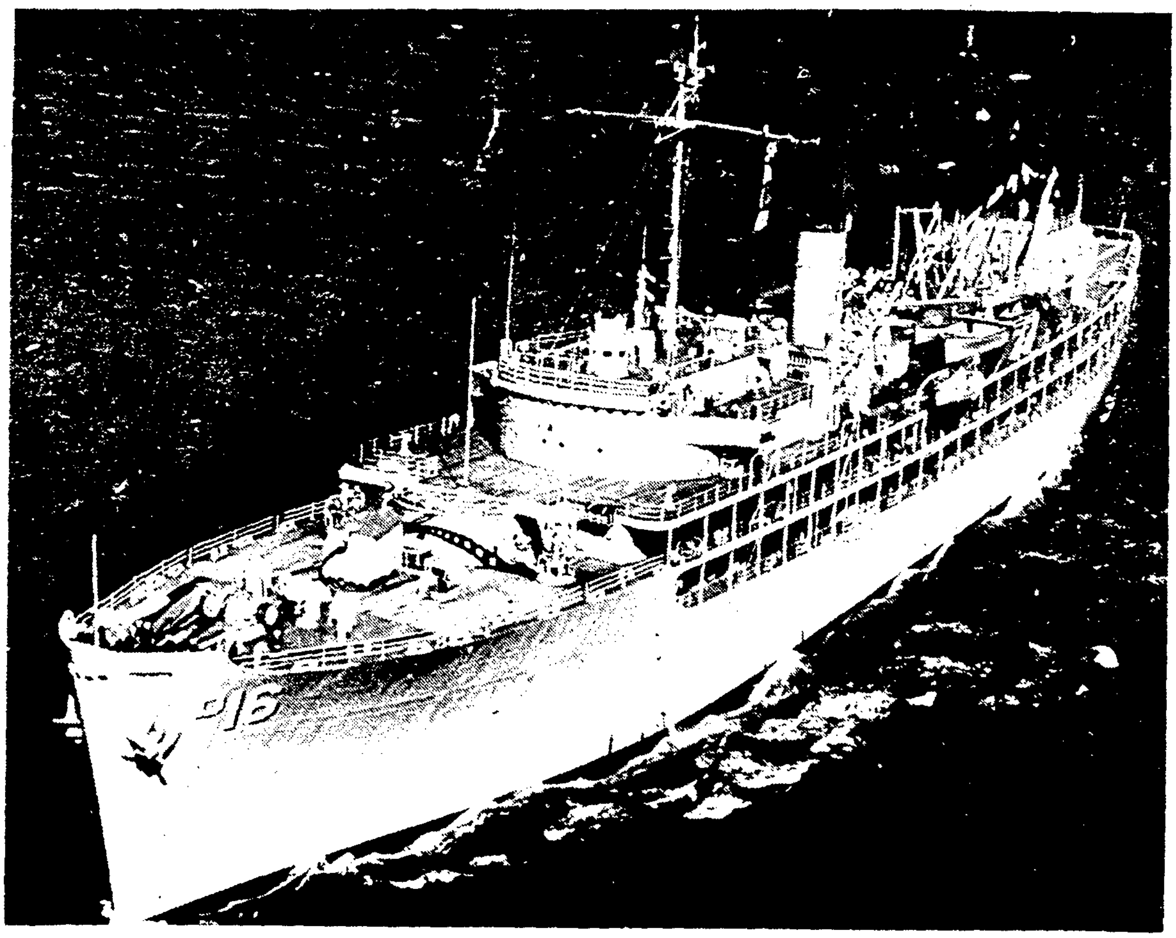

FIGURE 7. U.S.S. Cascade.

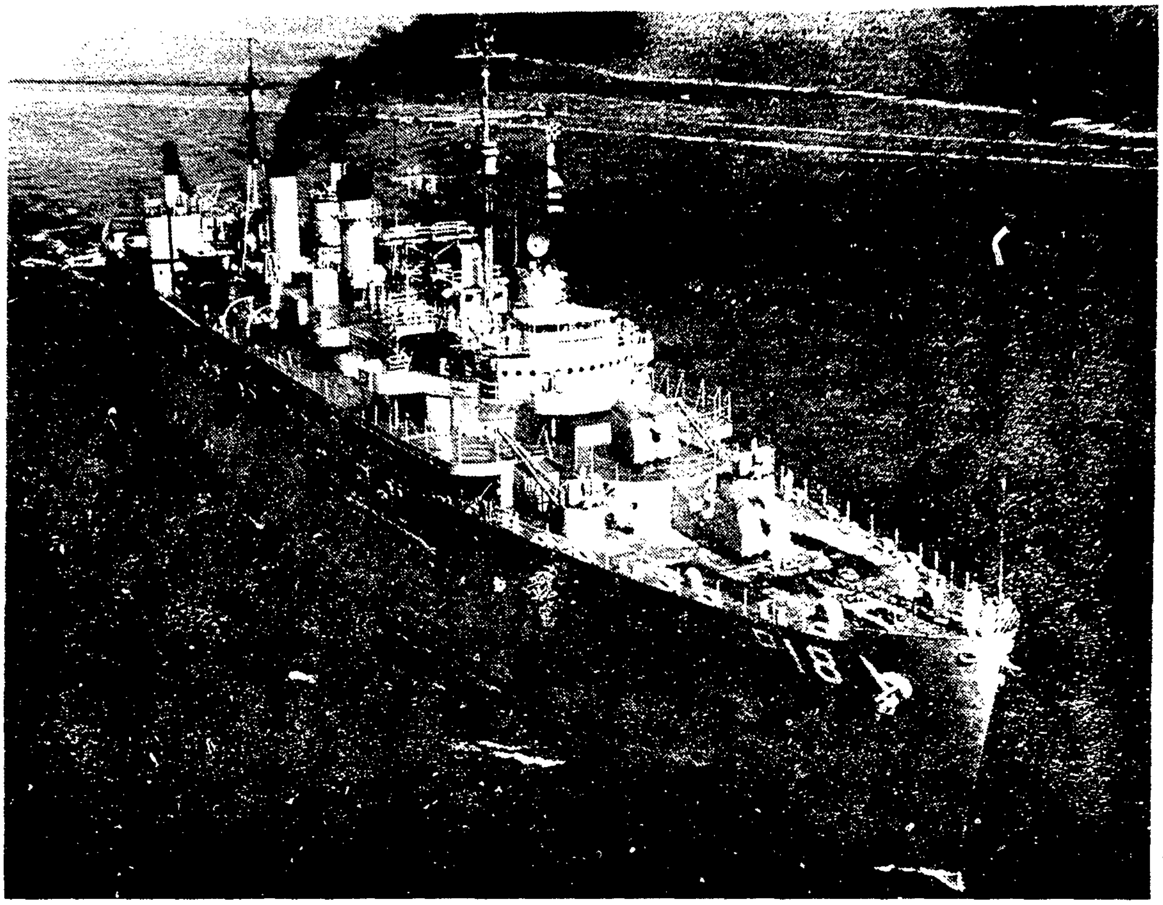

FIGURE 8. U.S.S. Sierra.

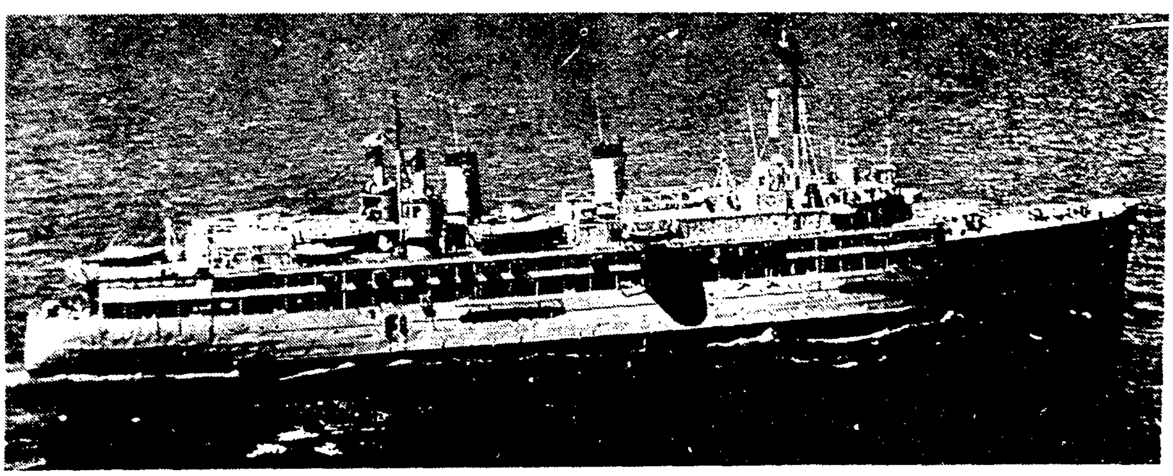

FIGURE 9. U.S.S. Yosemite.

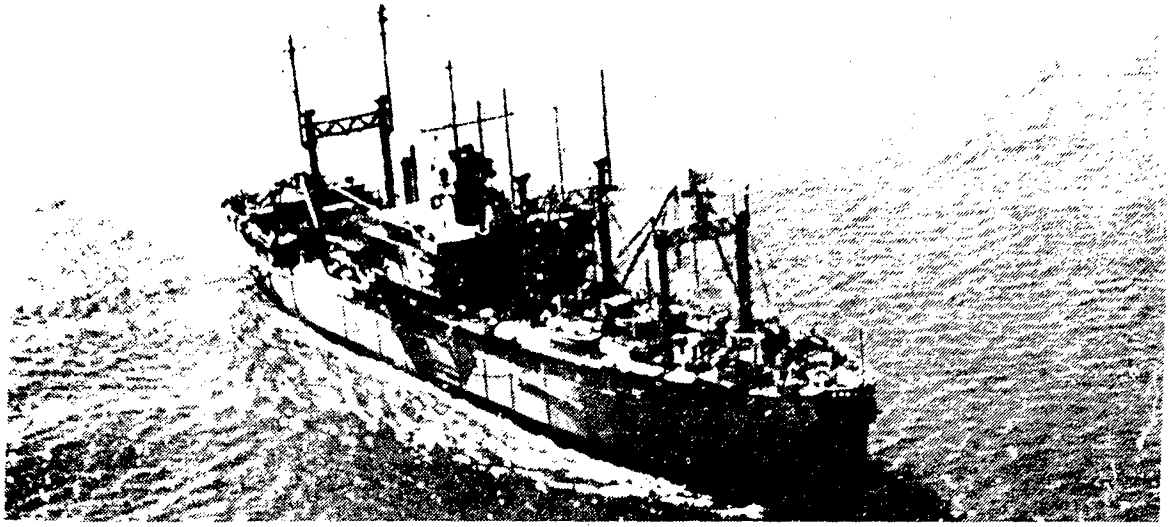

FIGURE 10. U.S.S. Arcadia.

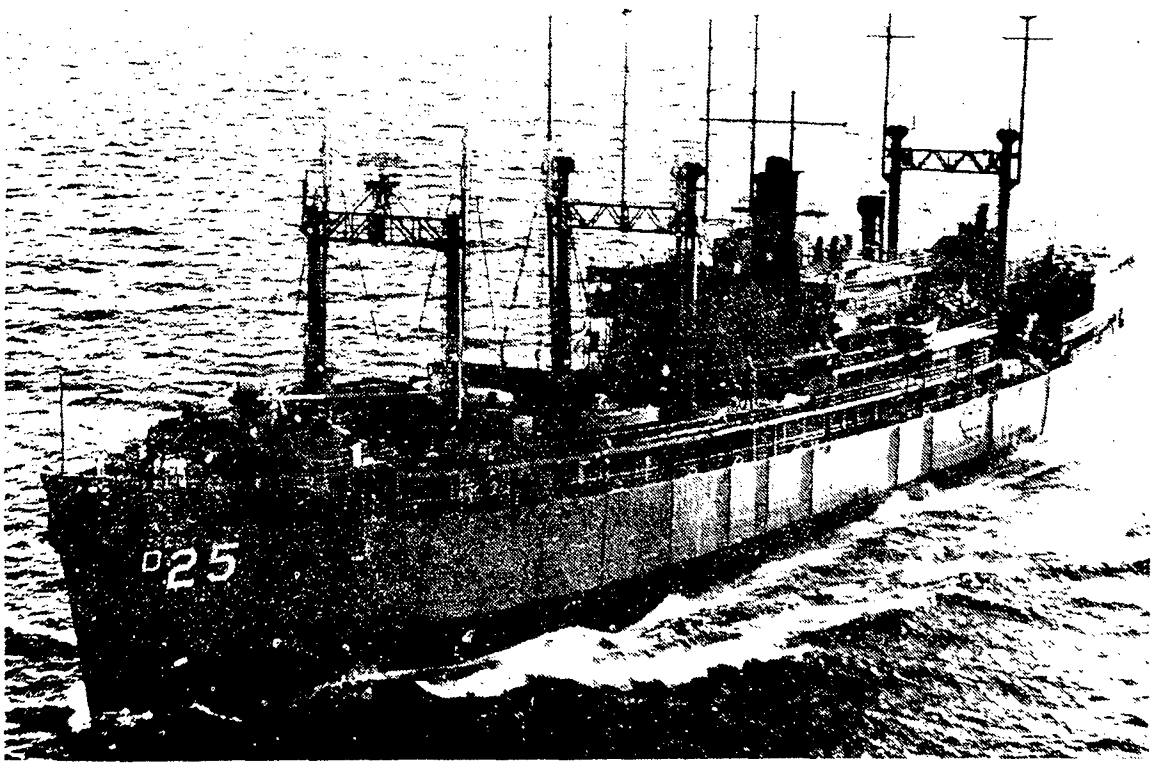

FIGURE 11. U.S.S. Frontier.

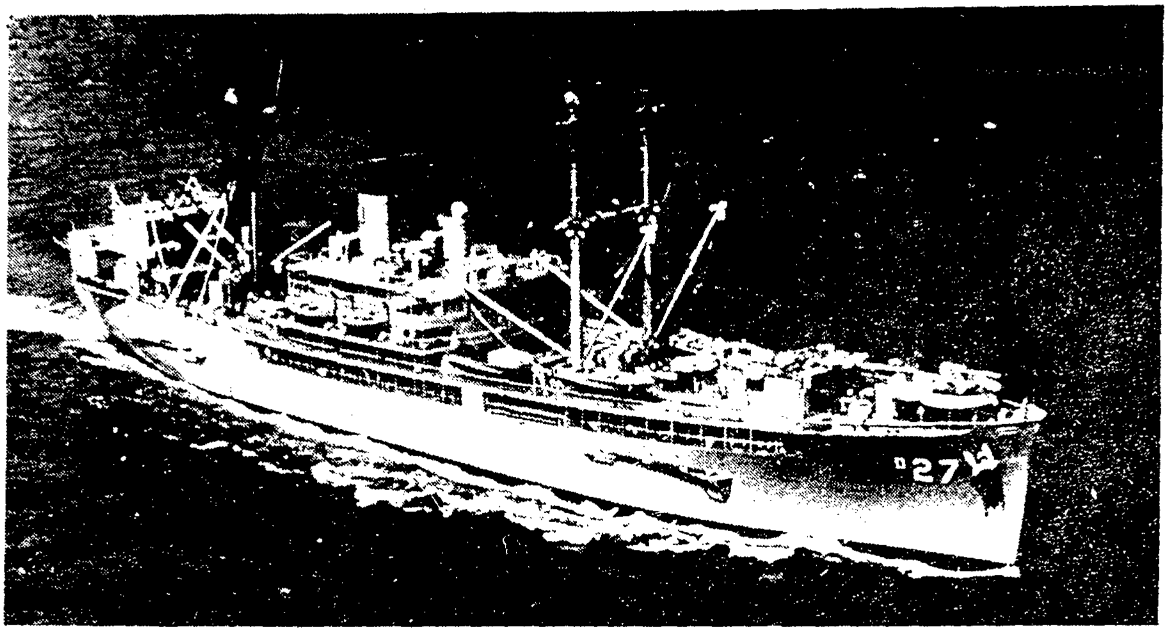

FIGURE 12. U.S.S. Yellowstone.

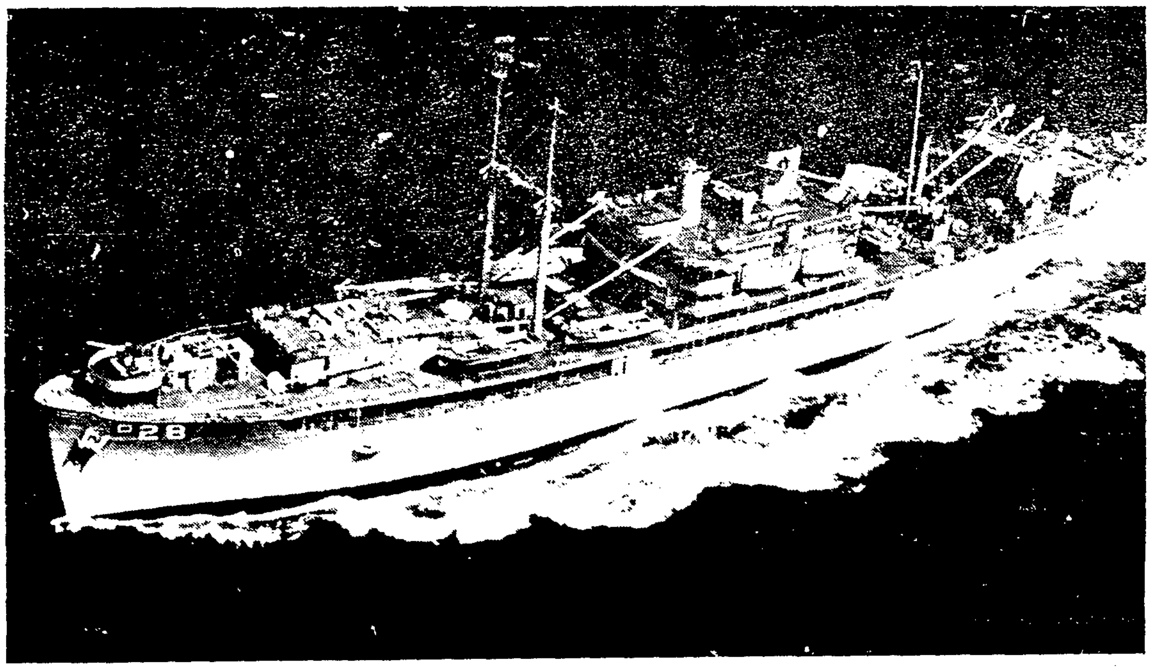

FIGURE 13. U.S.S. Grand Canyon.

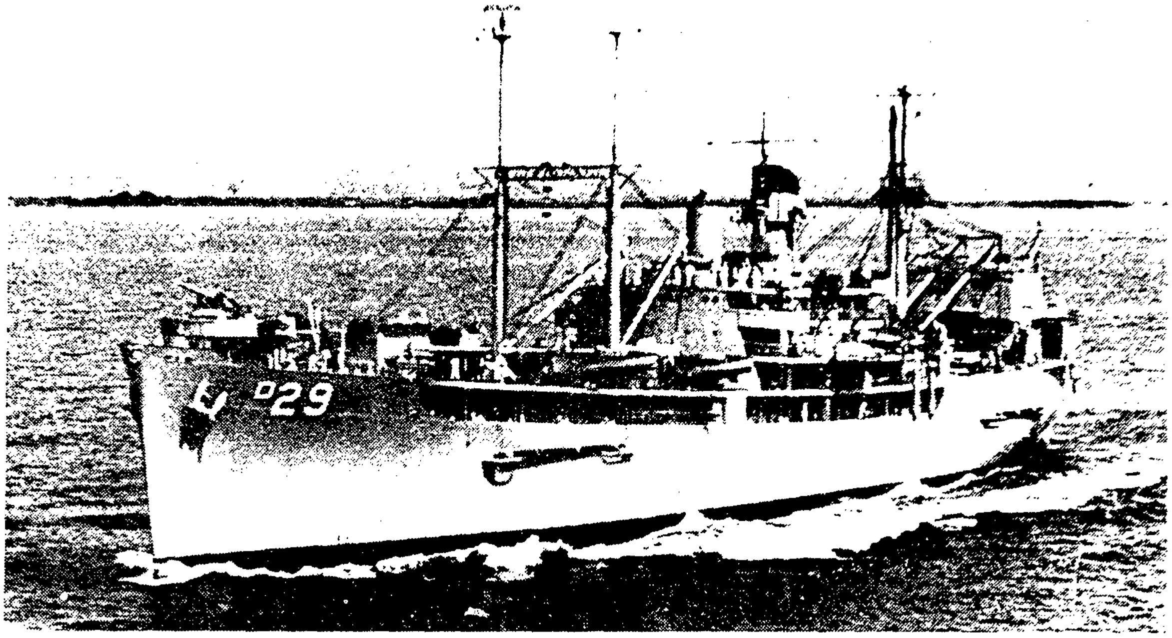

FIGURE 14. U.S.S. Isle Royale.

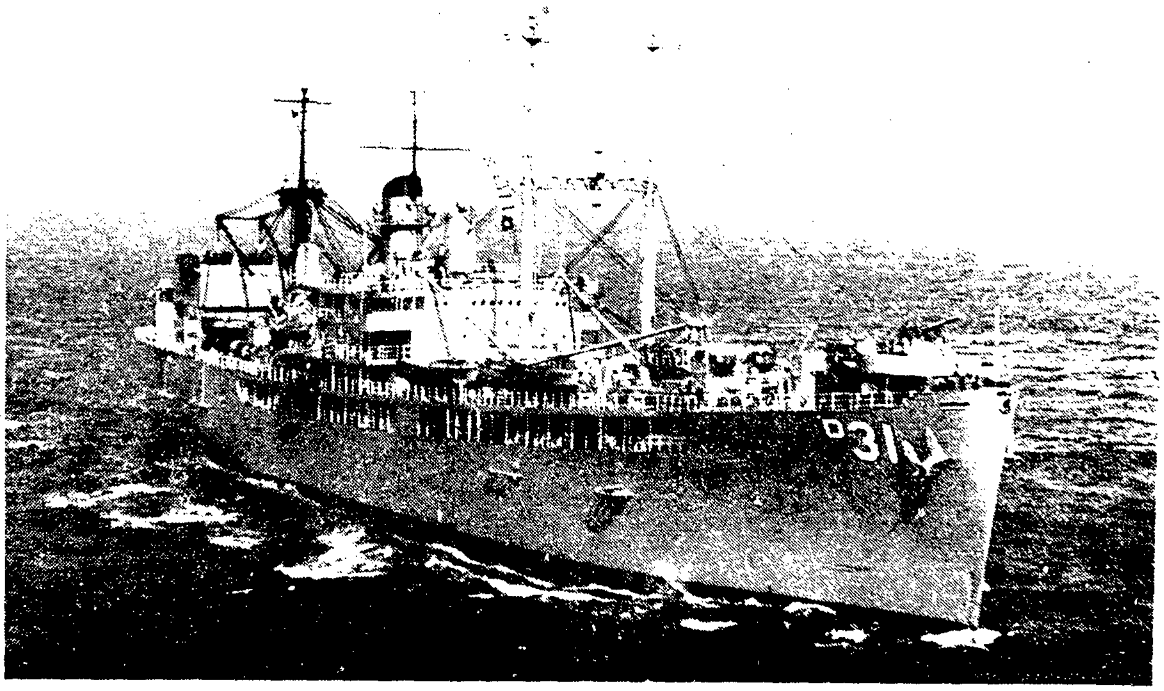

FIGURE 15. U.S.S. Tidewater.

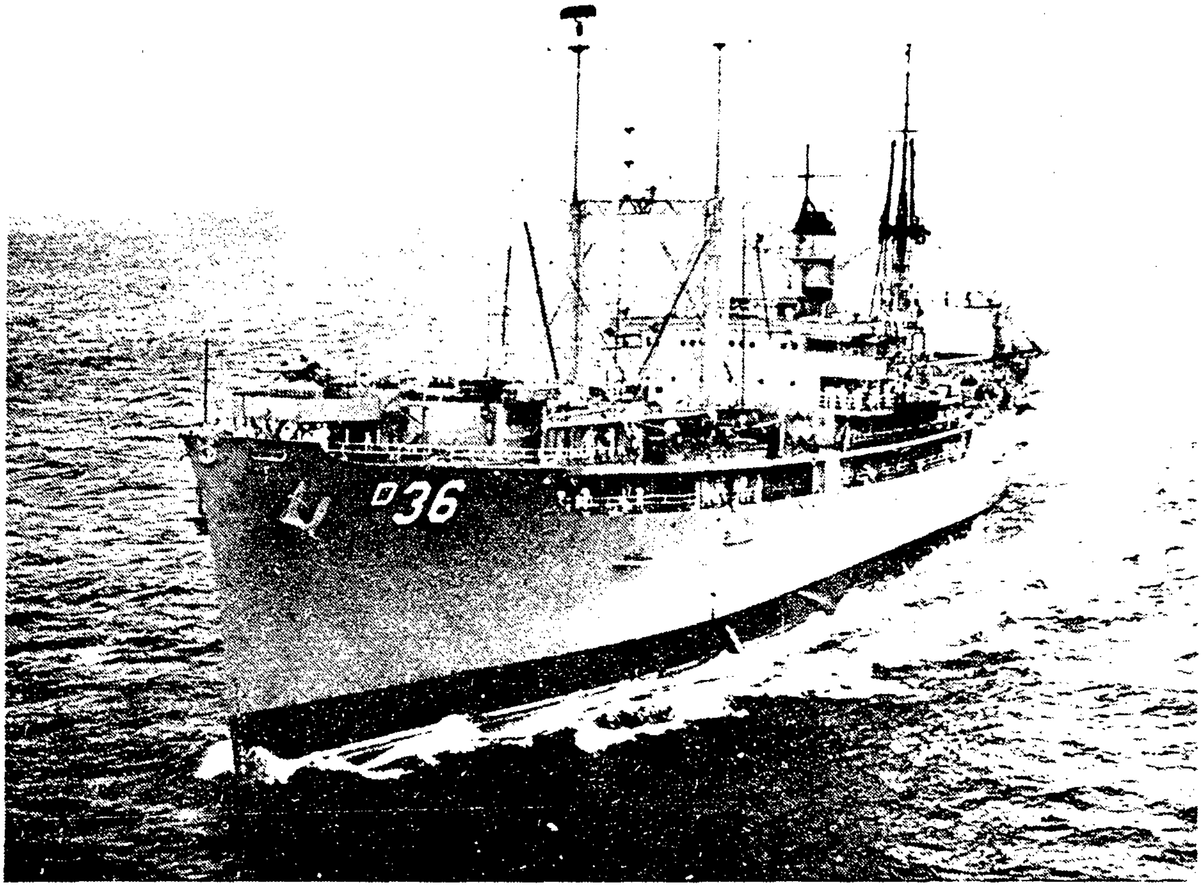

FIGURE 16. U.S.S. Bryce Canyon.

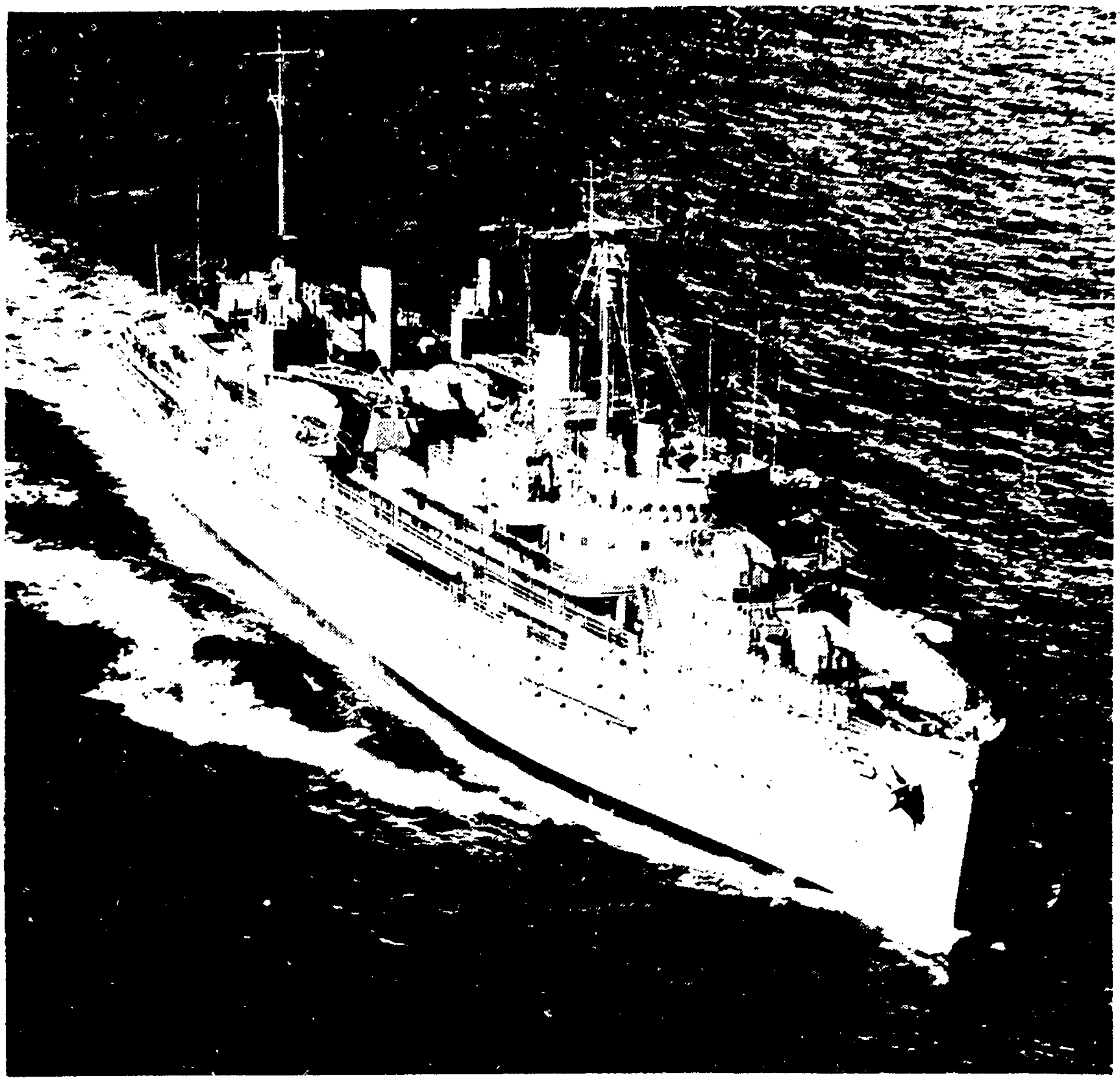

FIGURE 17. U.S.S. Ajax.

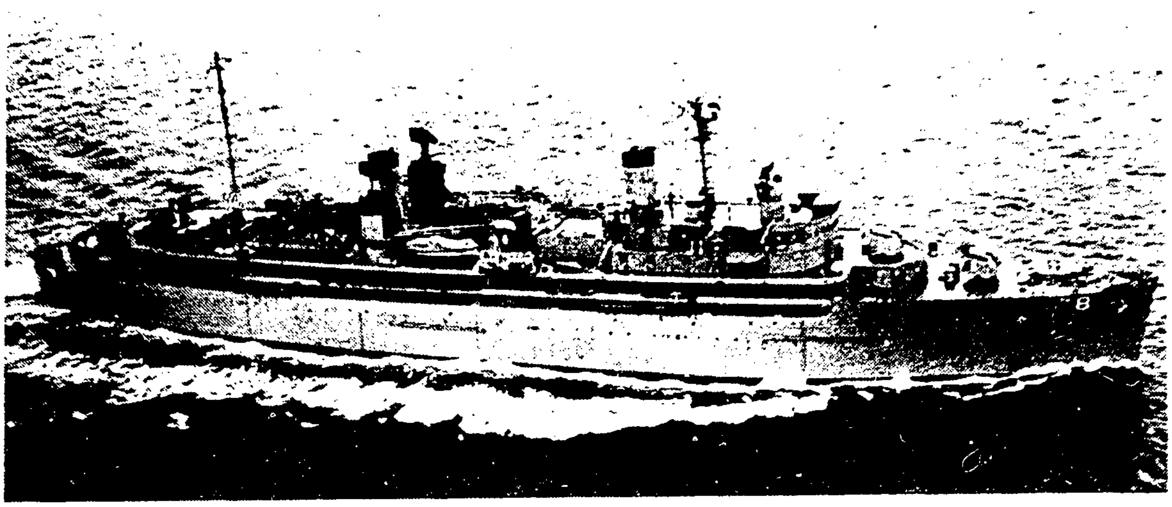

FIGURE 18. U.S.S. Jason.

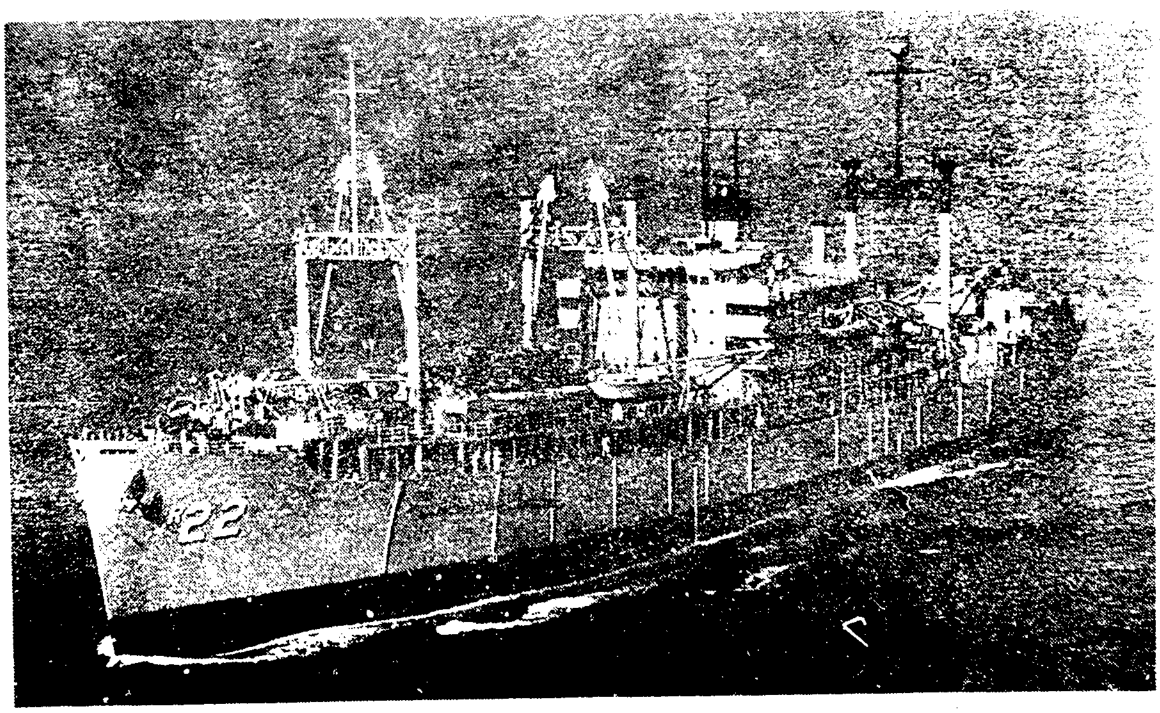

FIGURE 19. U.S.S. Klondike.

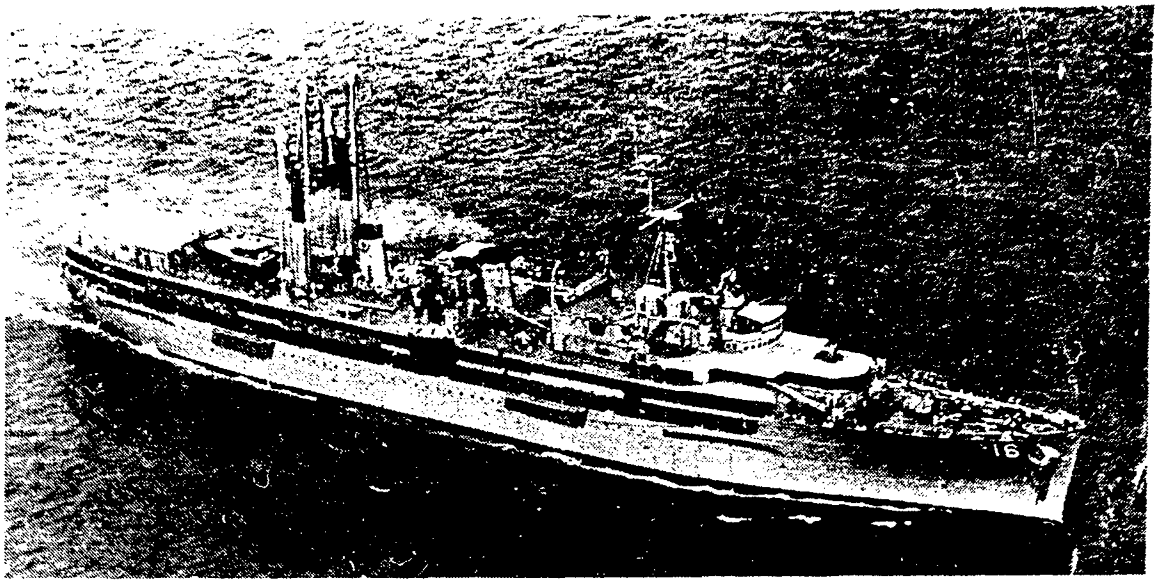

FIGURE 20. U.S.S. Gilmore.

FIGURE 21. U.S.S. Orion.

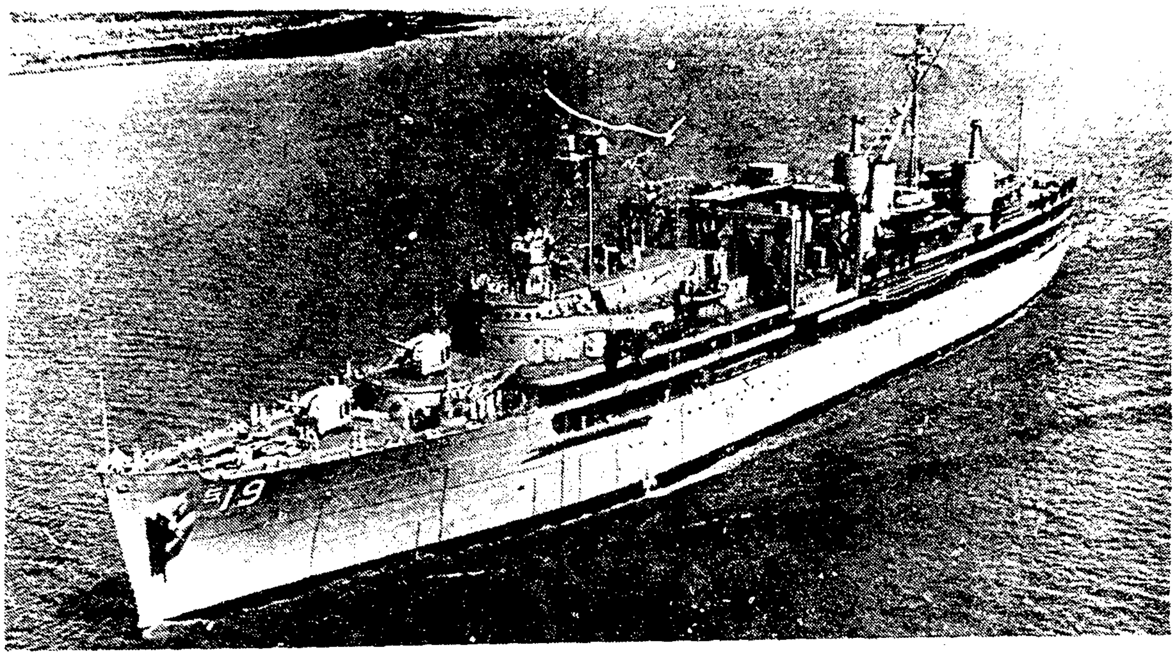

FIGURE 22. U.S.S. Proteus.

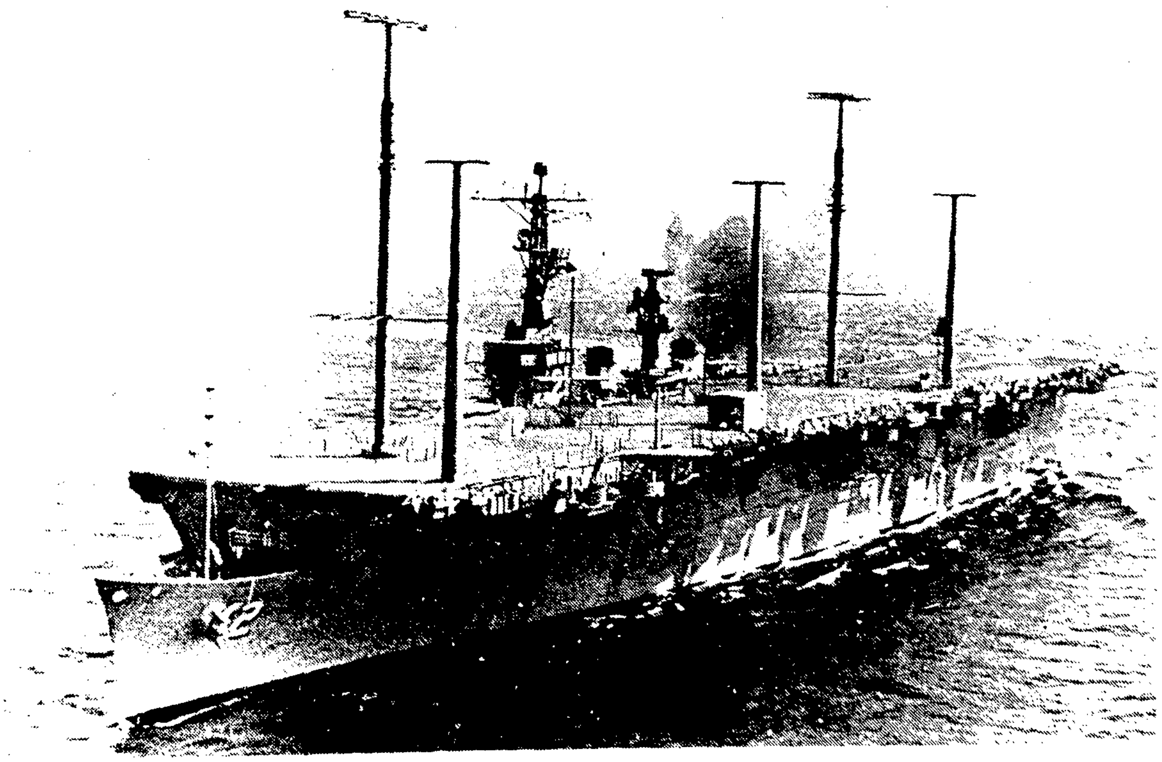

FIGURE 23. U.S.S. Wright.

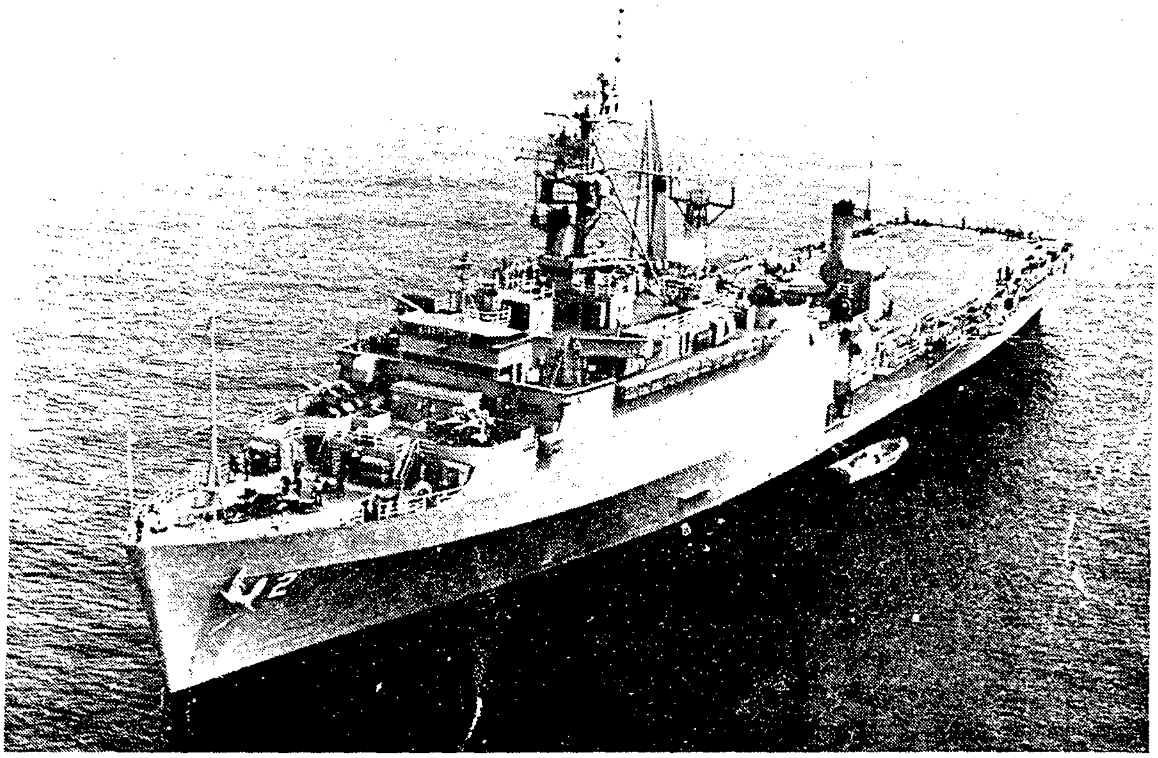

FIGURE 24. U.S.S. Vancouver.

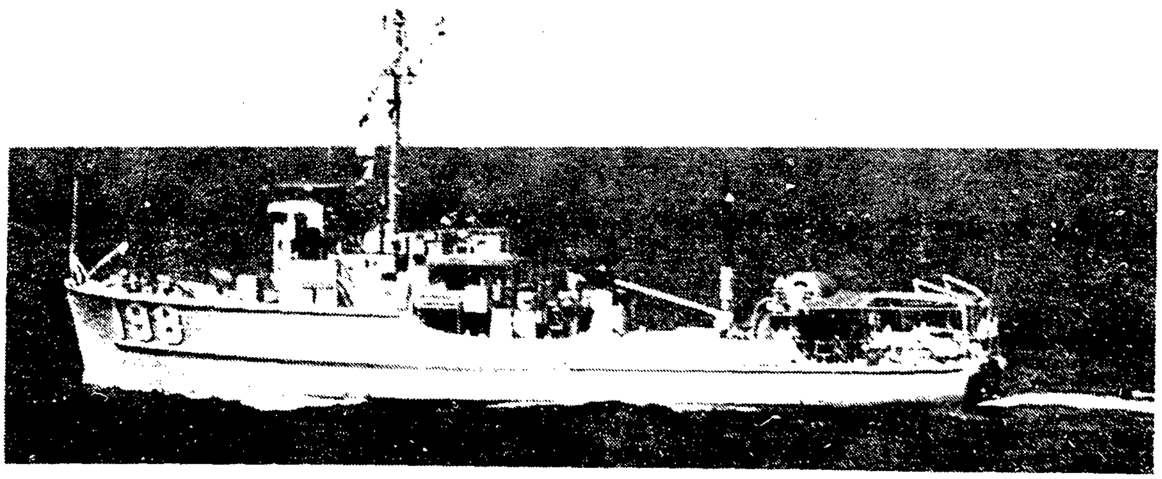

Figure 25. U.S.S. Peacock

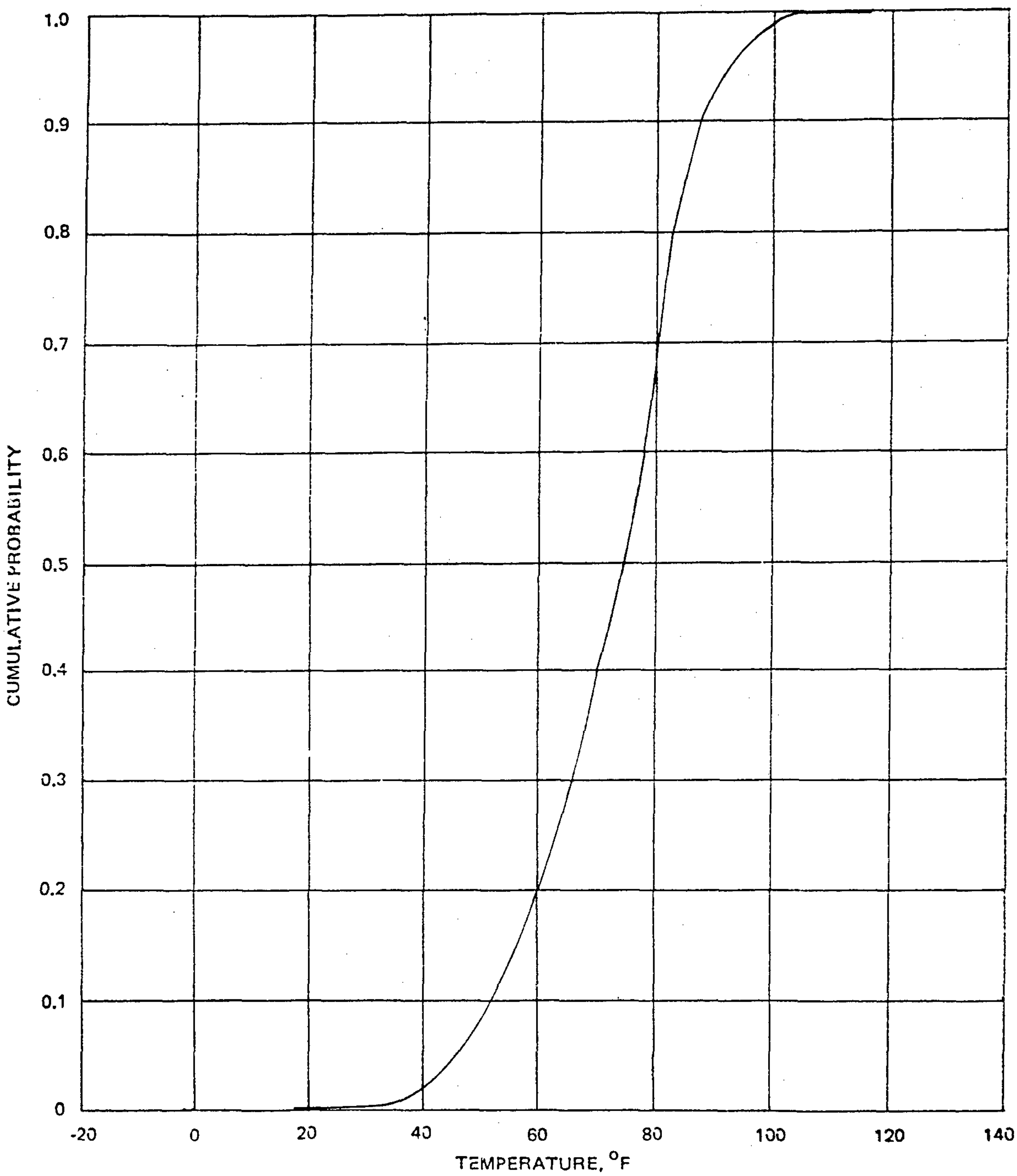

FIGURE 26. Cumulative Probability of Occurrence, AE 01.

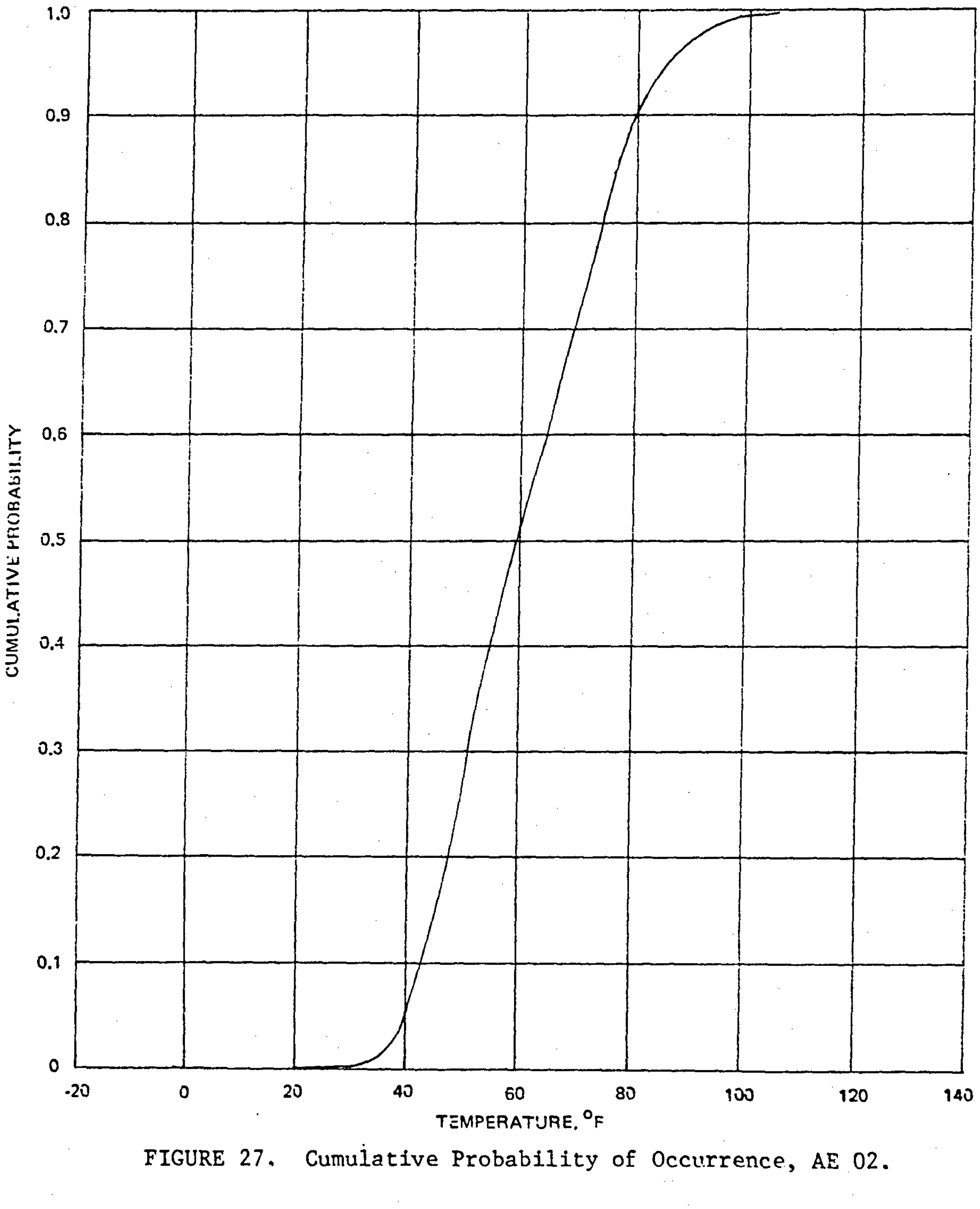

FIGURE 27. Cumulative Probability of Occurrence, AE 02.

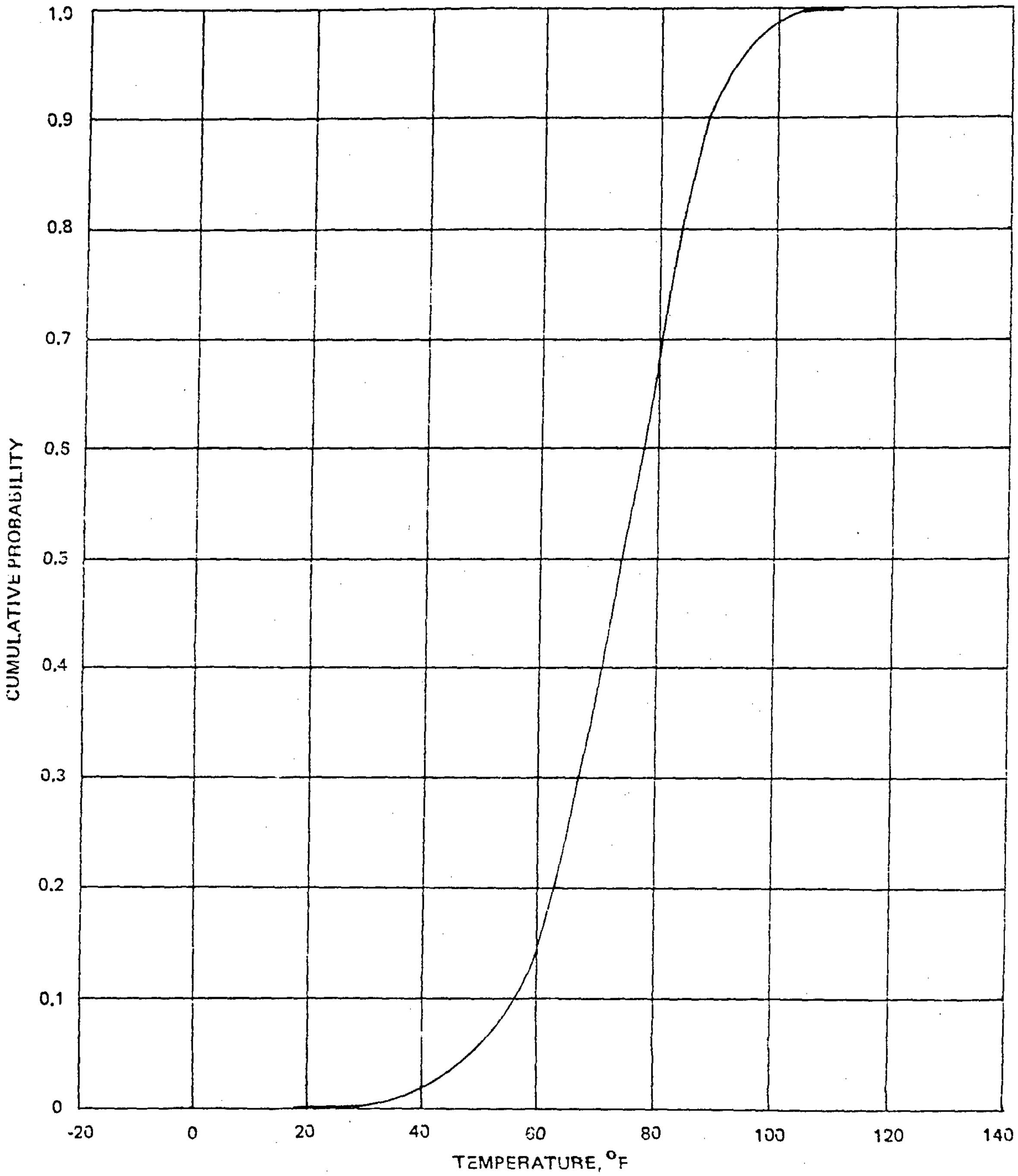

FIGURE 28. Cumulative Probability of Occurrence, AE 03.

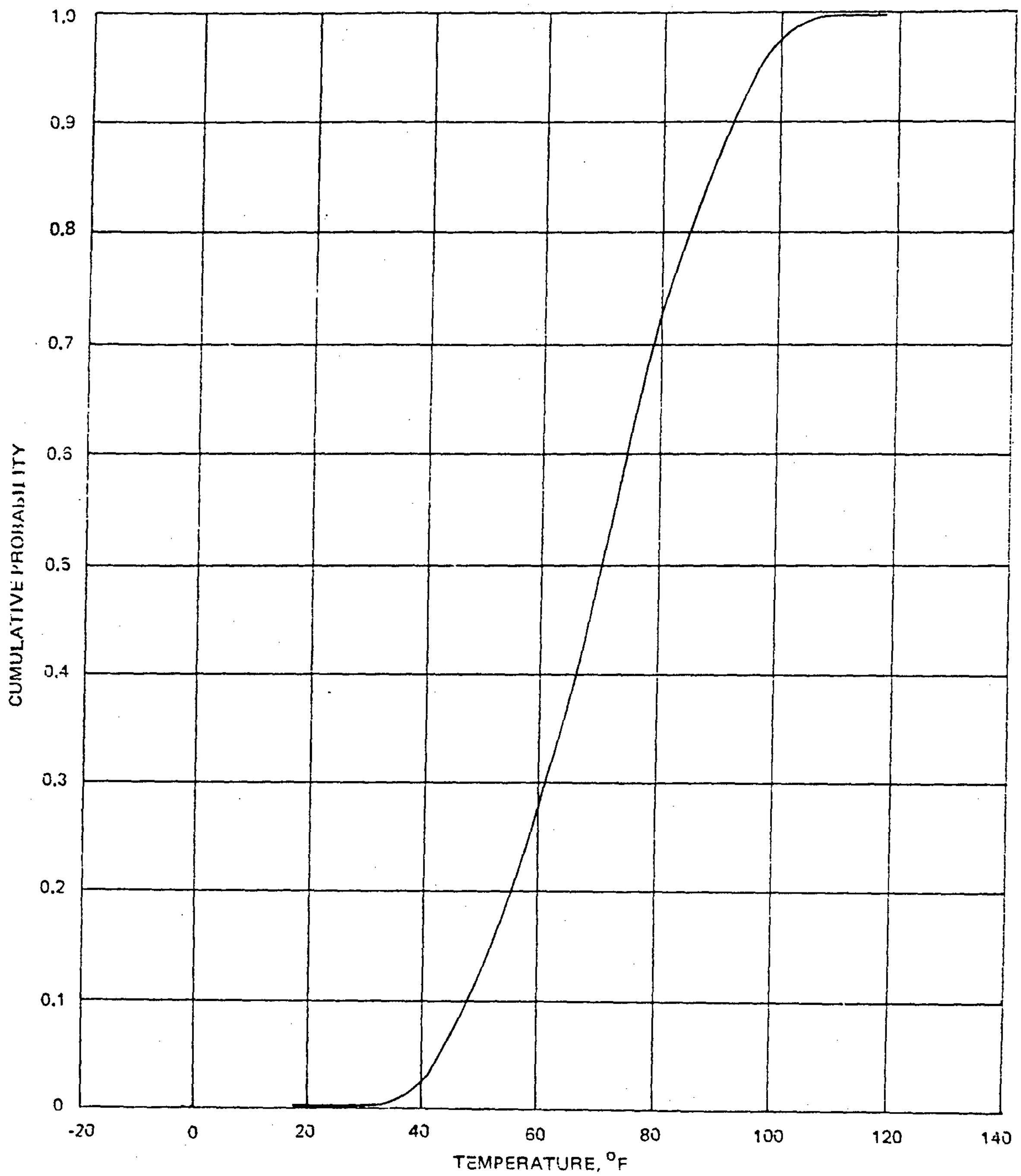

FIGURE 29. Cumulative Probability of Occurrence, AE 04.

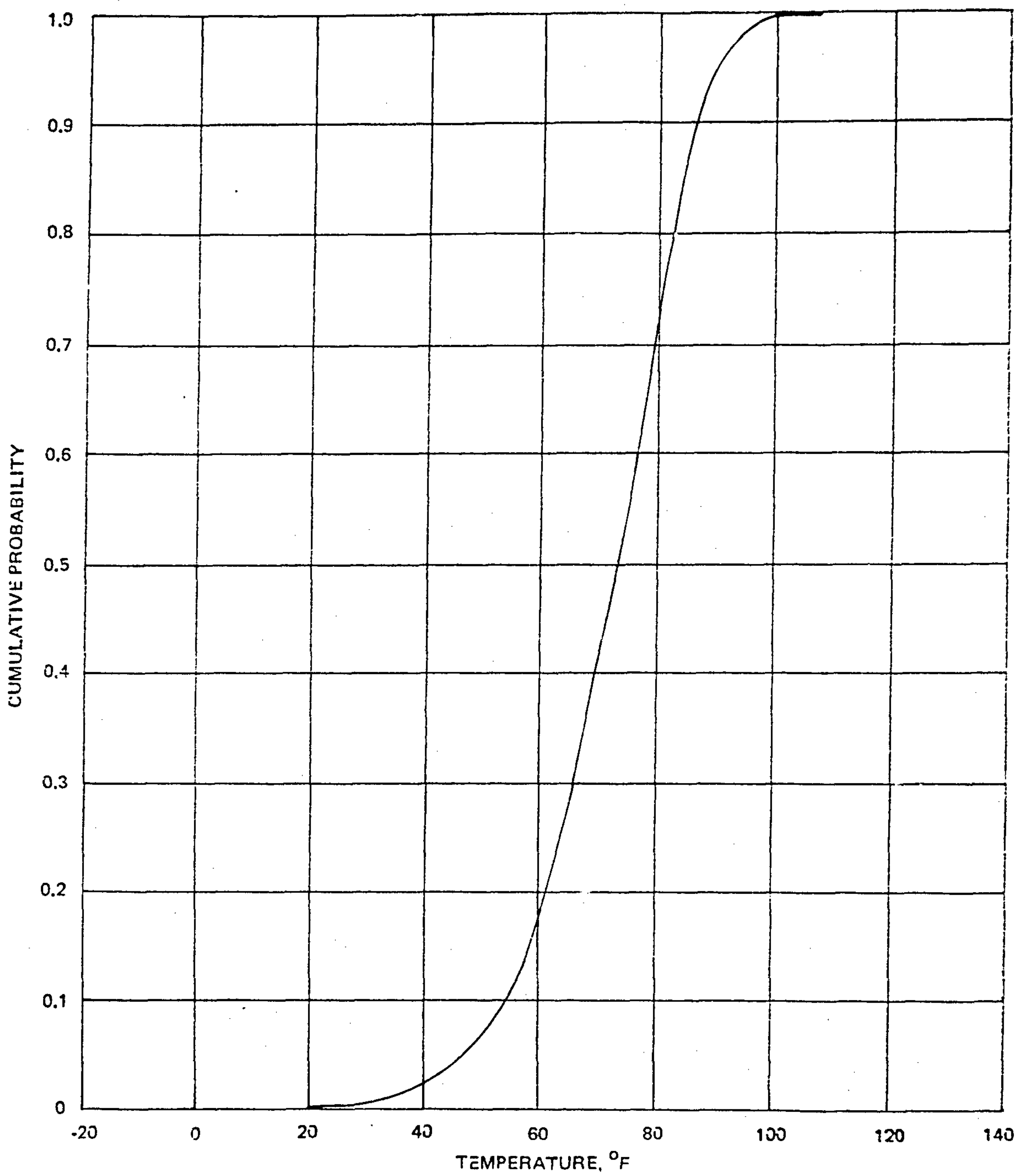

FIGURE 30. Cumulative Probability of Occurrence, AE 1.

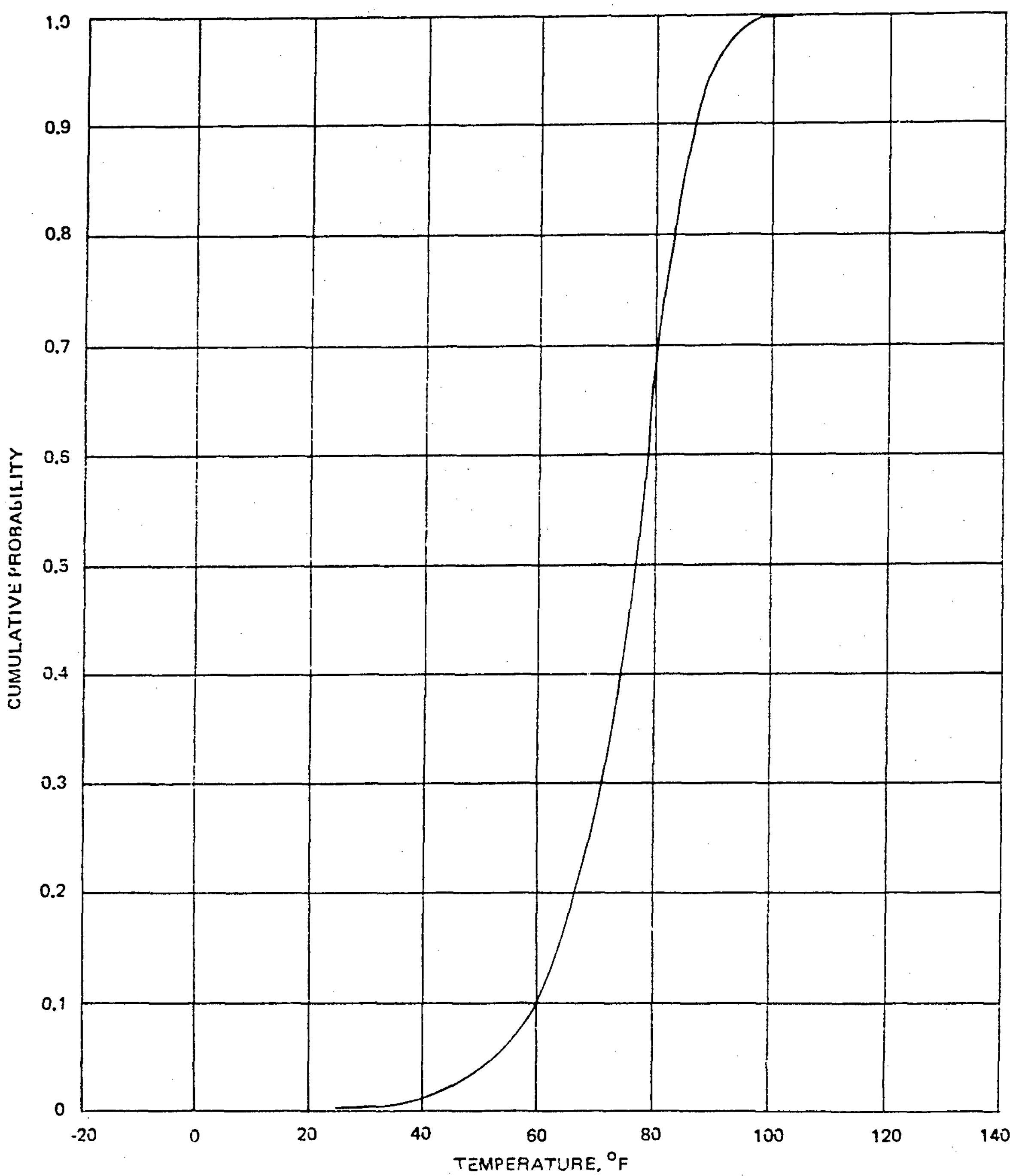

FIGURE 31. Cumulative Probability of Occurrence, AE 2.

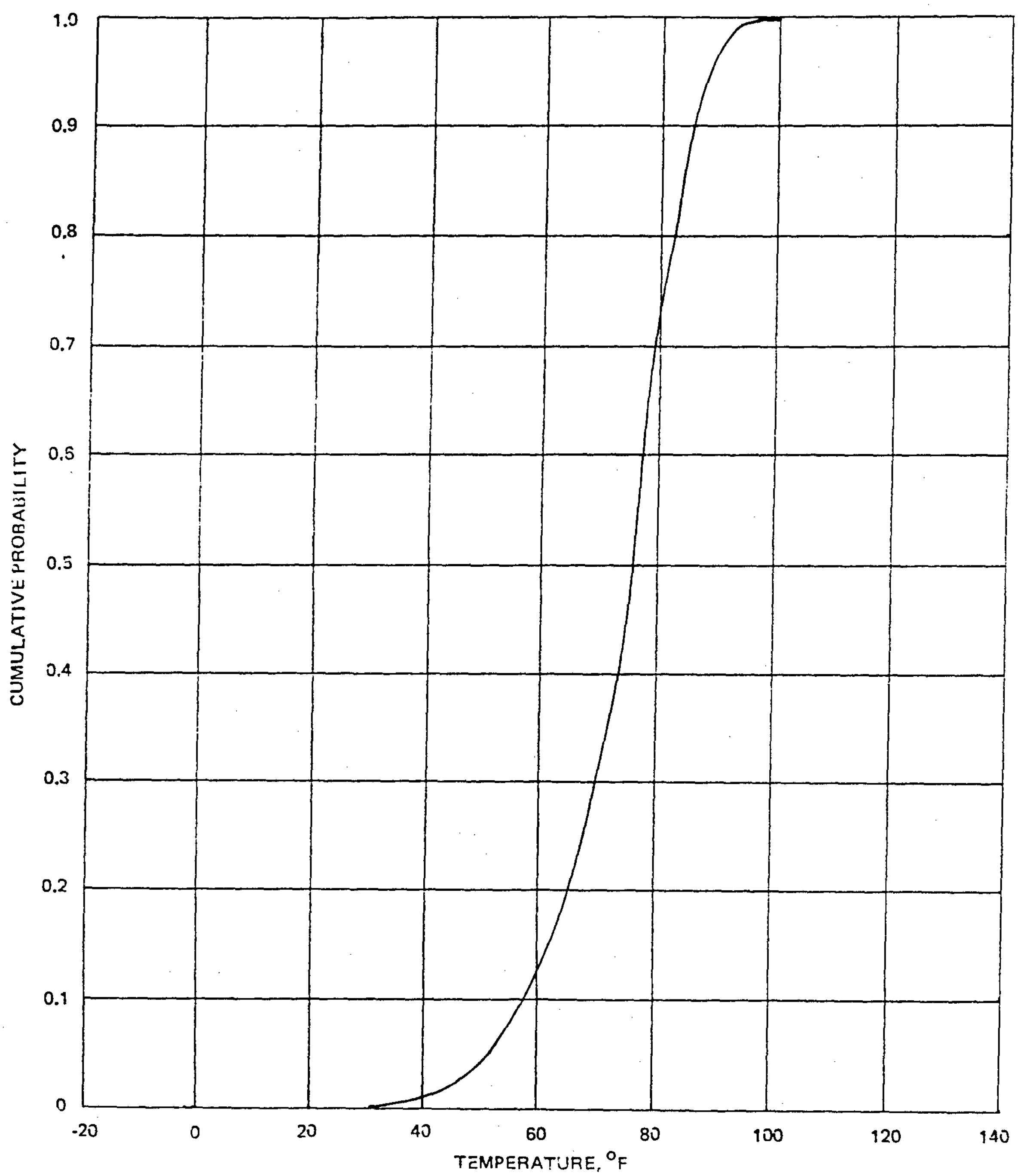

FIGURE 32. Cumulative Probability of Occurrence, AE 3.

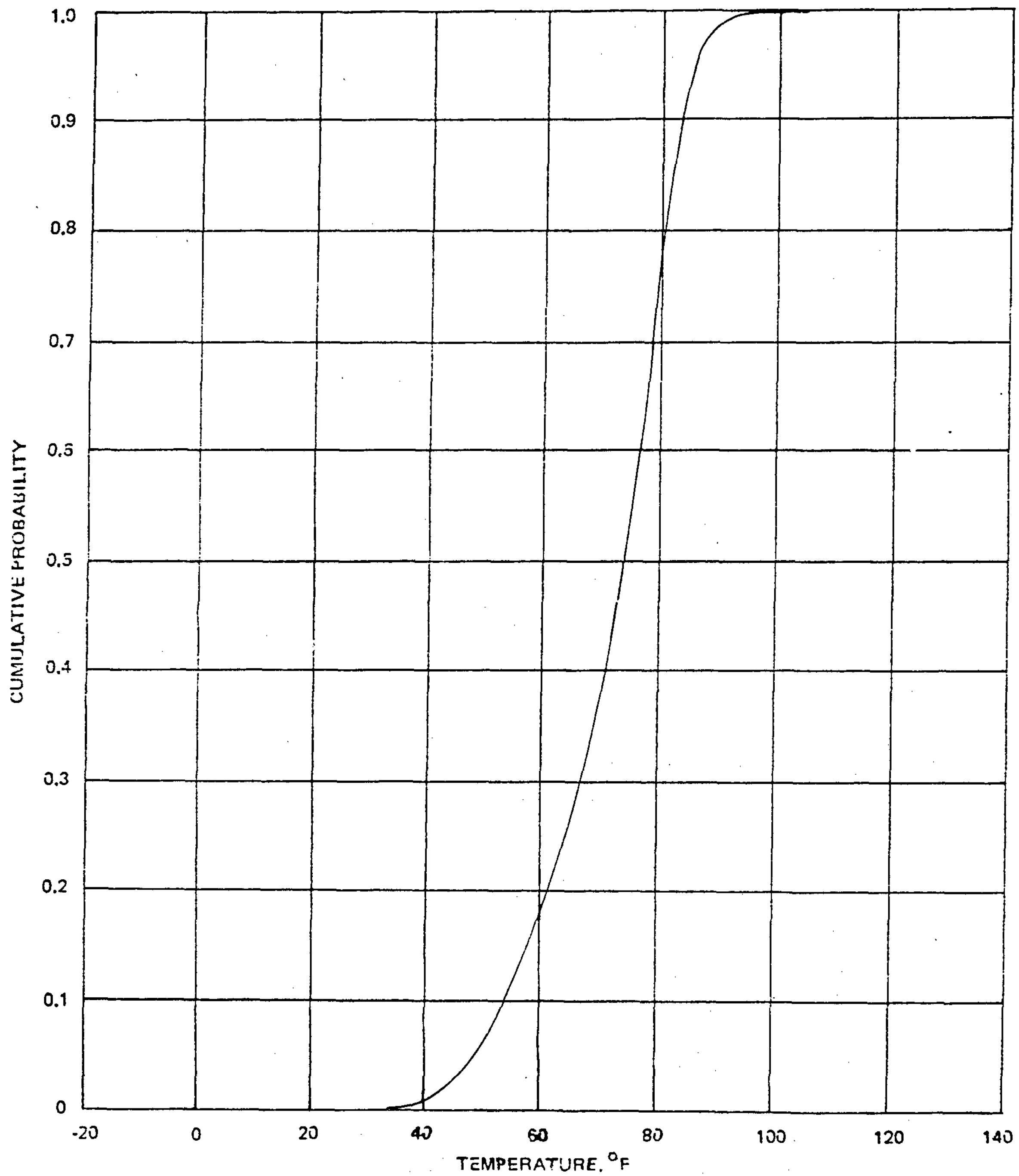

FIGURE 33. Cumulative Probability of Occurrence, AE 4.

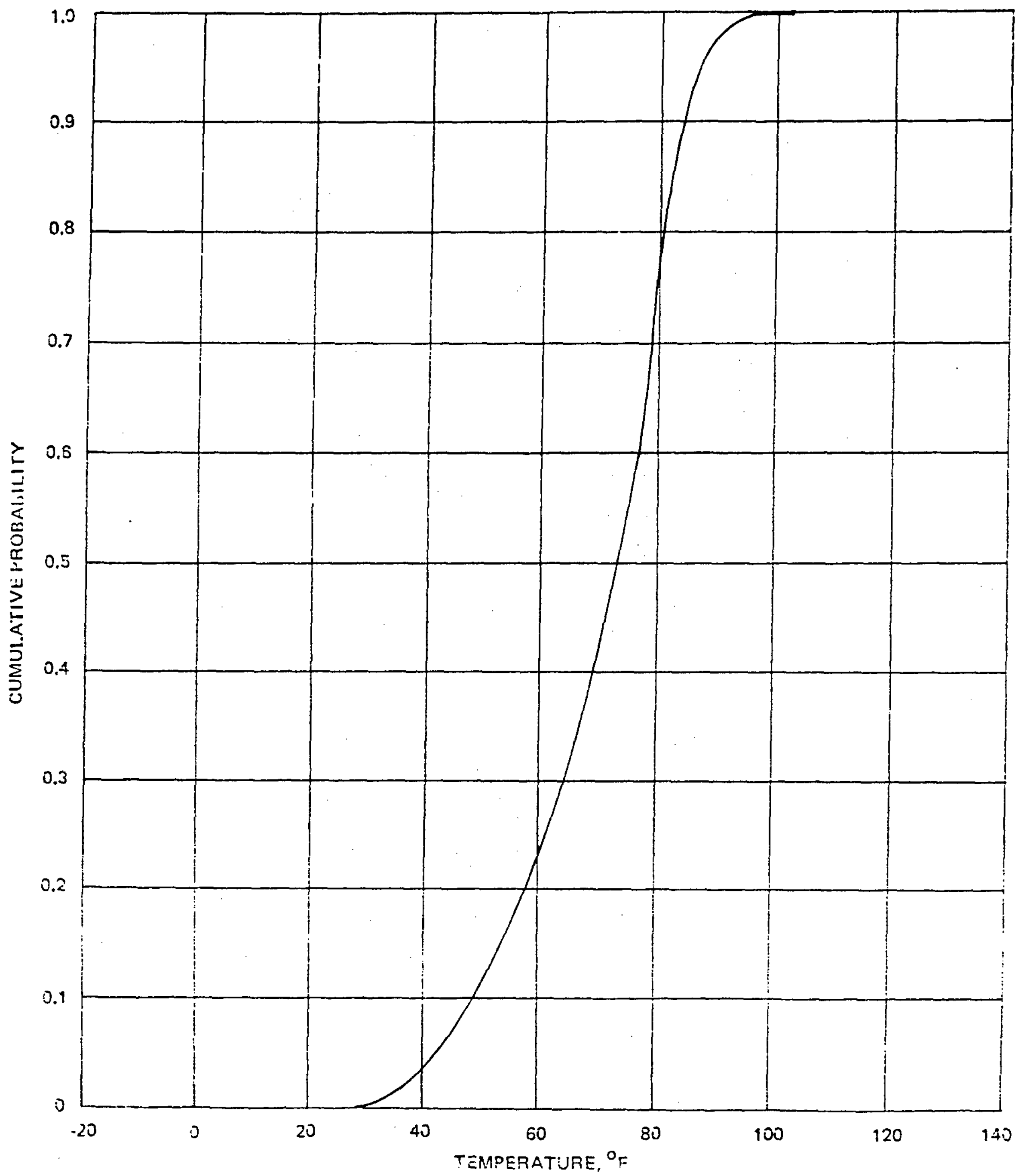

FIGURE 34. Cumulative Probability of Occurrence, AE 5.

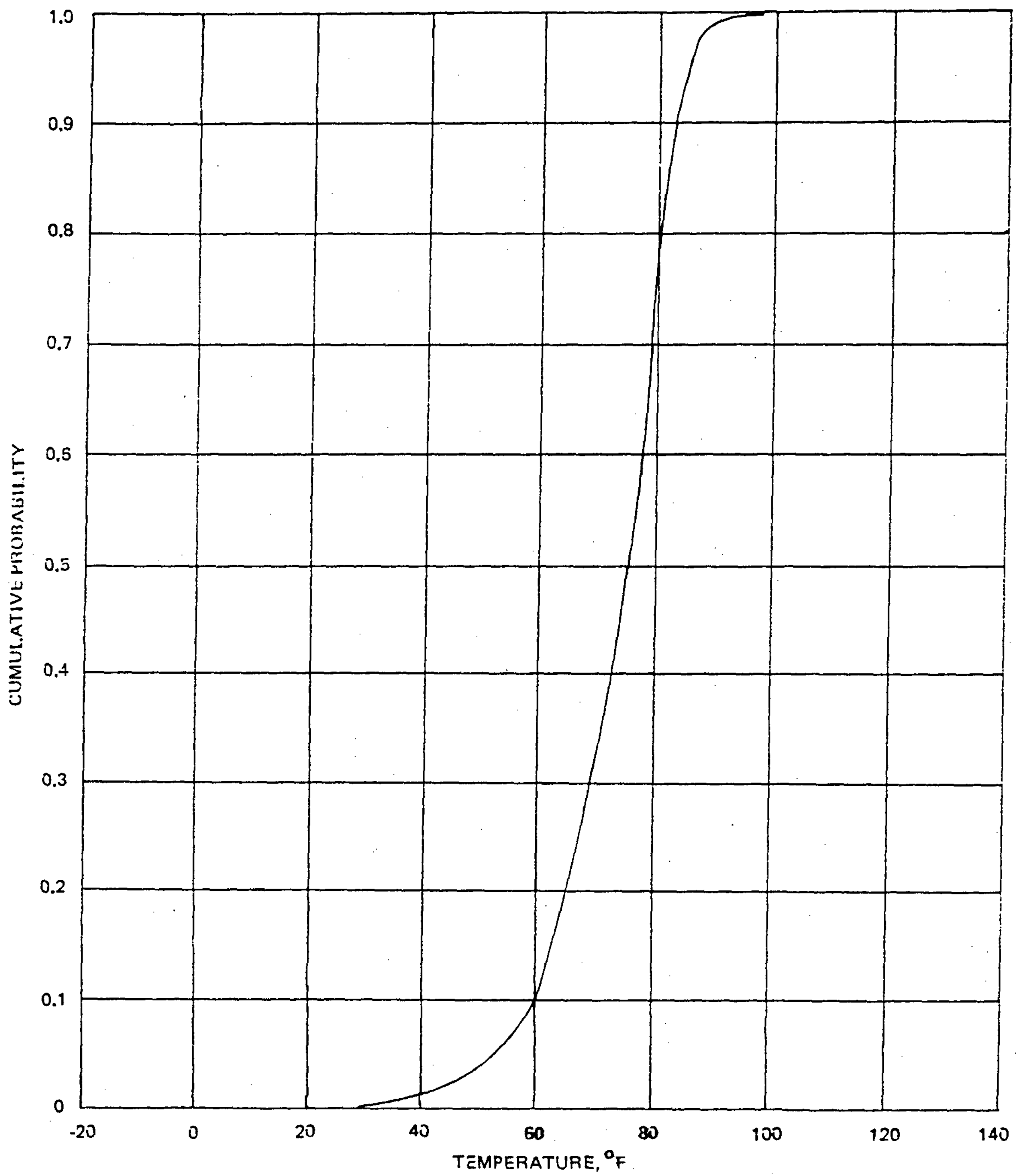

FIGURE 35. Cumulative Probability of Occurrence, AE 6.

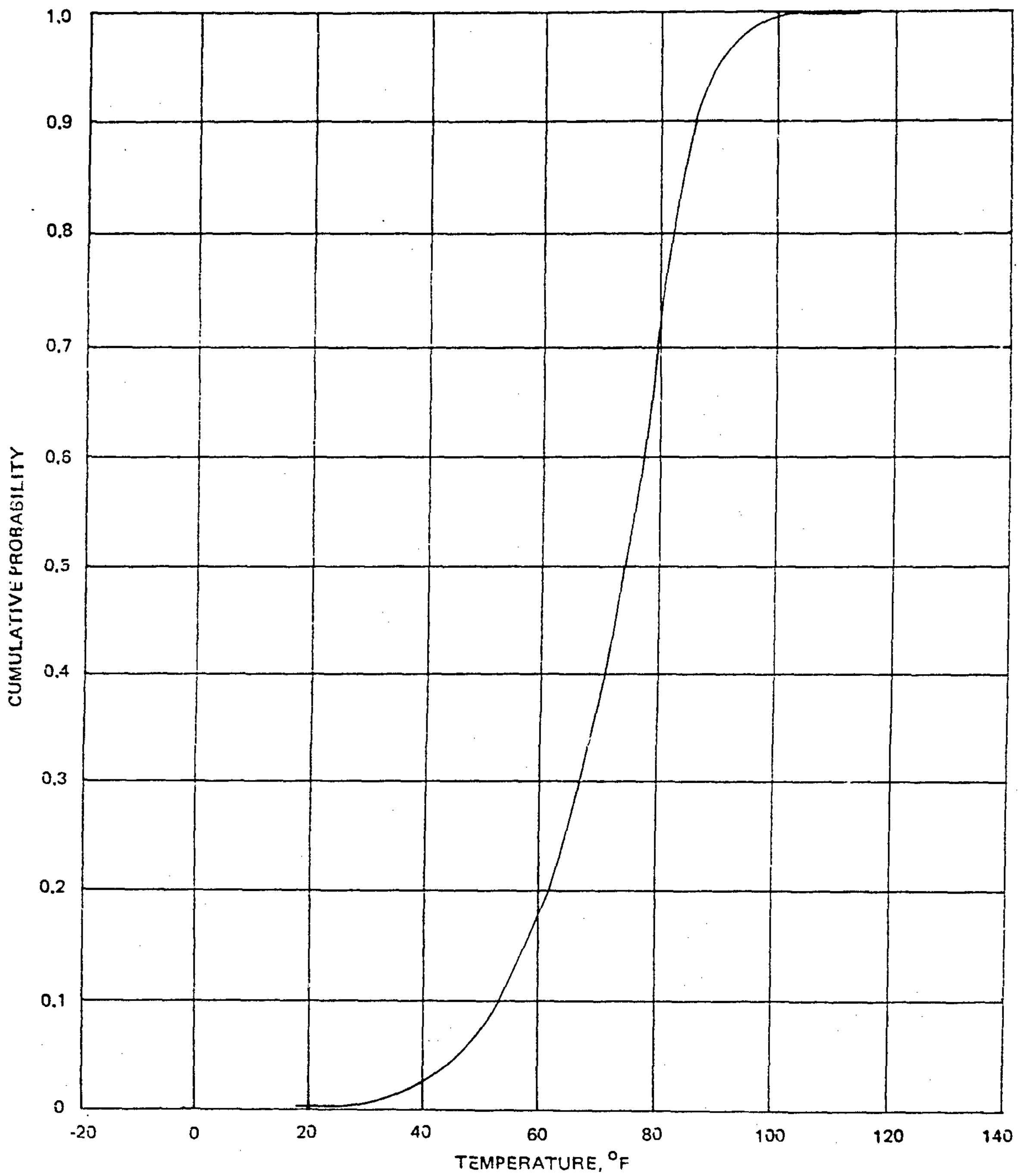

FIGURE 36. Cumulative Probability of Occurrence.
AE Upper Deck Composite.

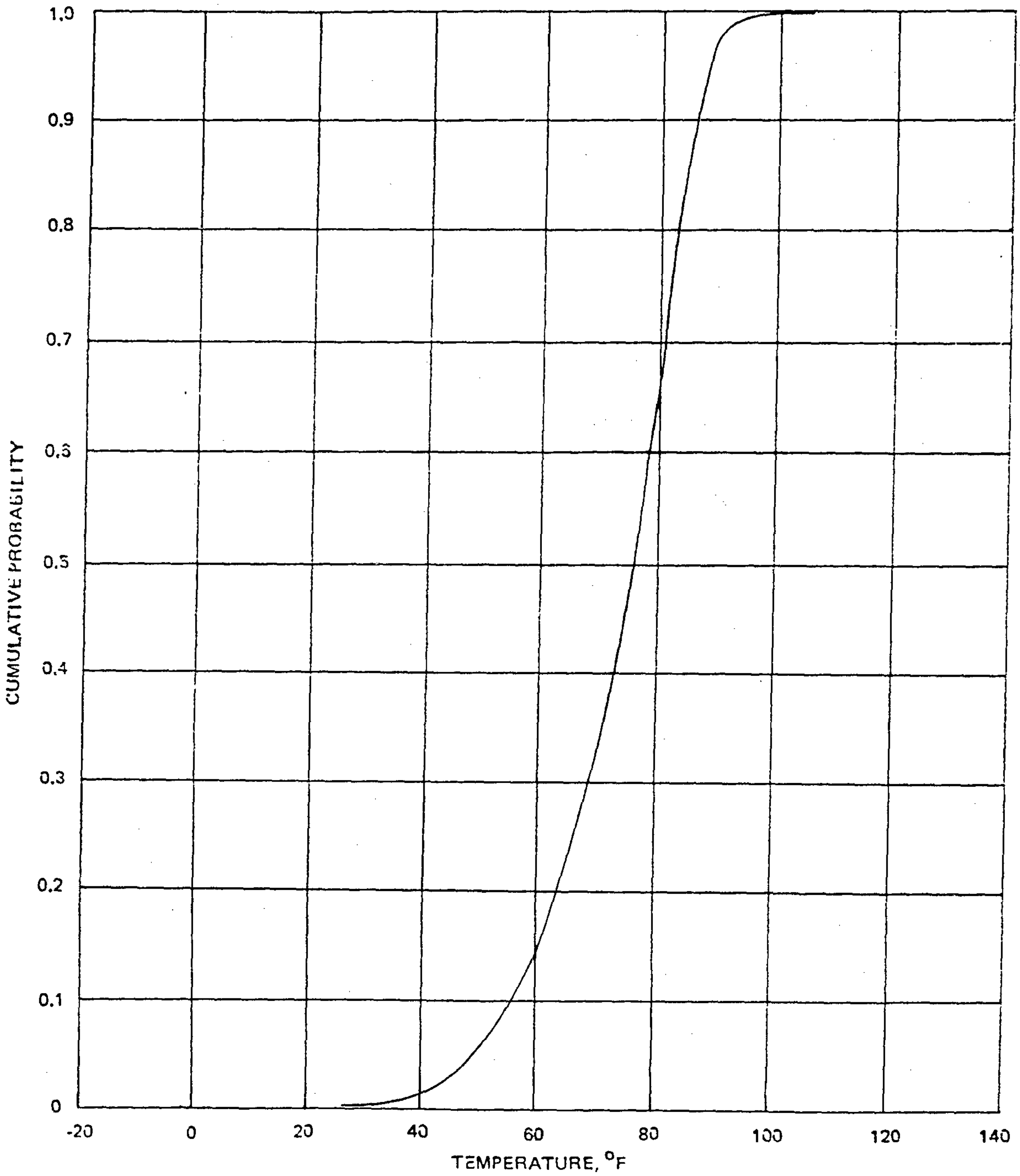

FIGURE 37. Cumulative Probability of Occurrence, AE Lower Deck Composite.

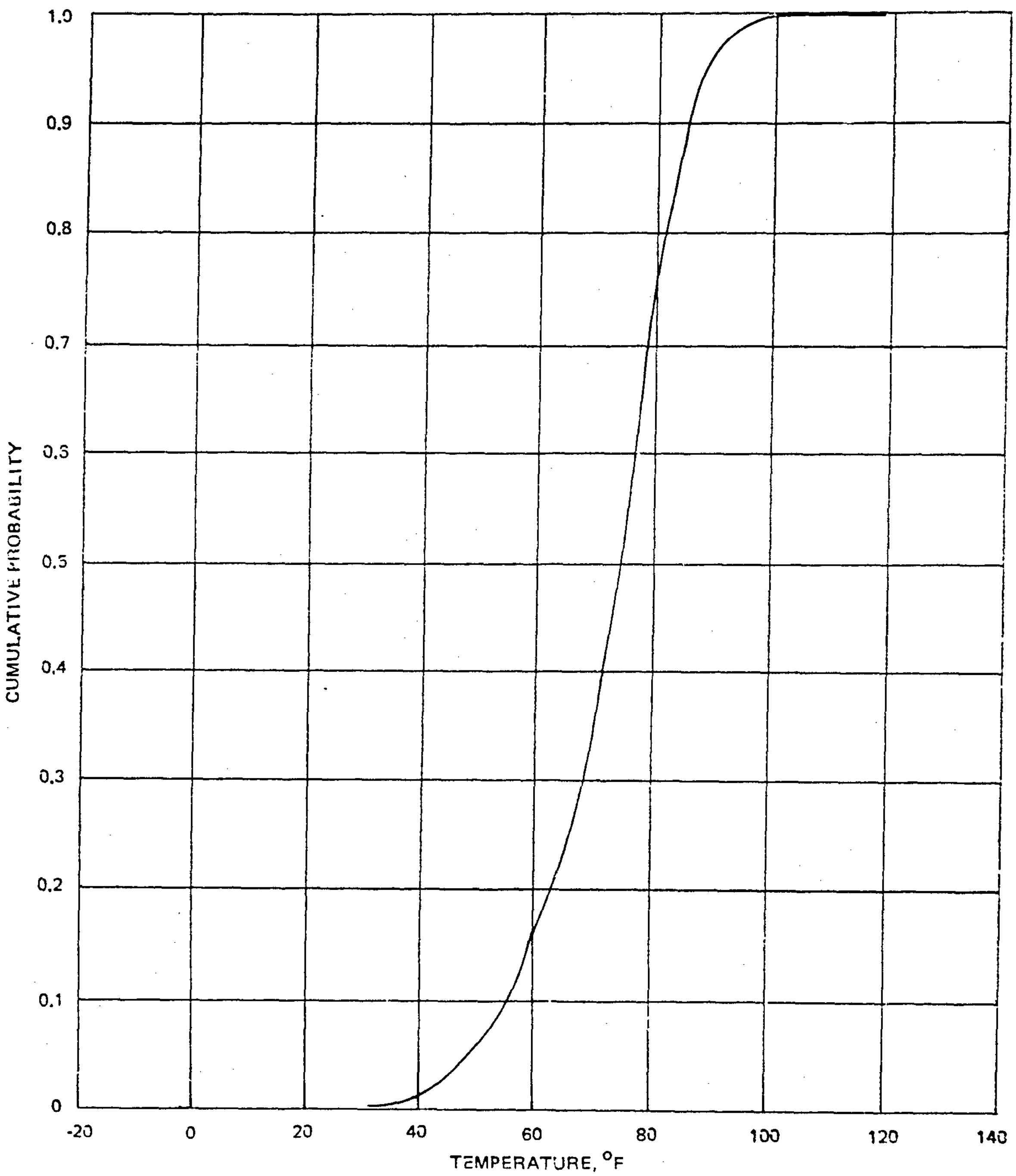

FIGURE 38. Cumulative Probability of Occurrence, AE All Data Combined.

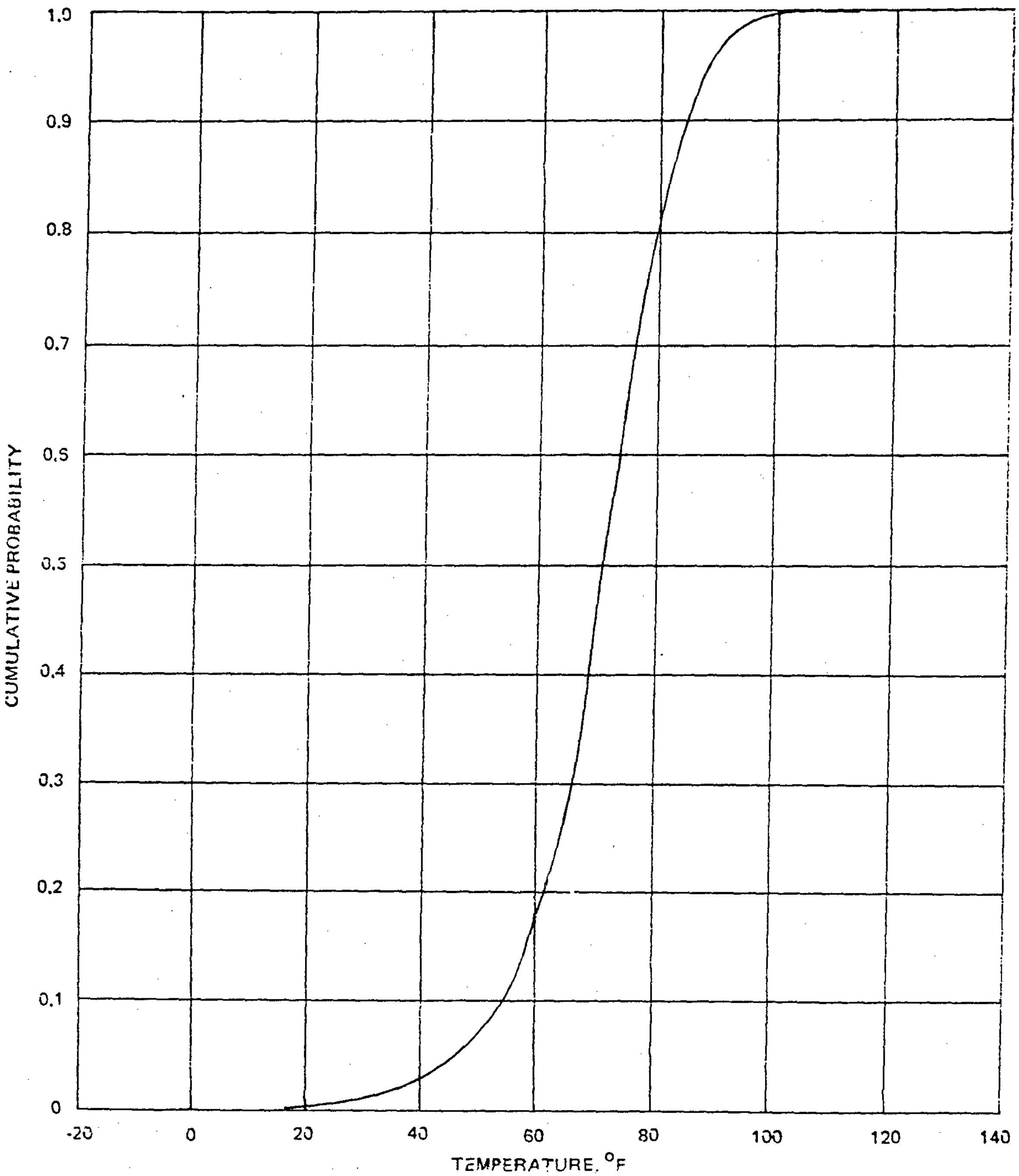

FIGURE 39. Cumulative Probability of Occurrence, AD Upper Deck Composite.

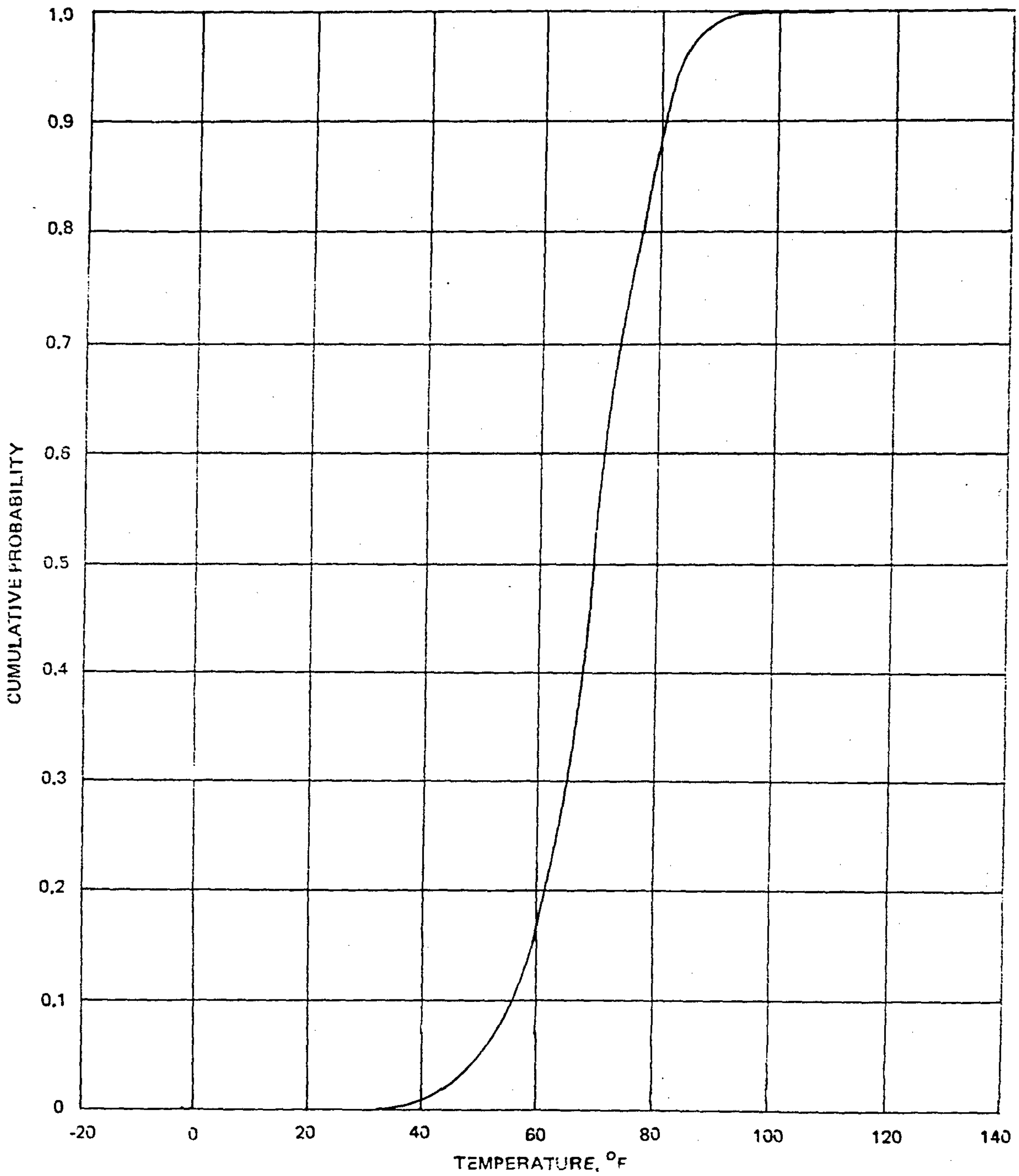

FIGURE 40. Cumulative Probability of Occurrence, AD Lower Deck Composite.

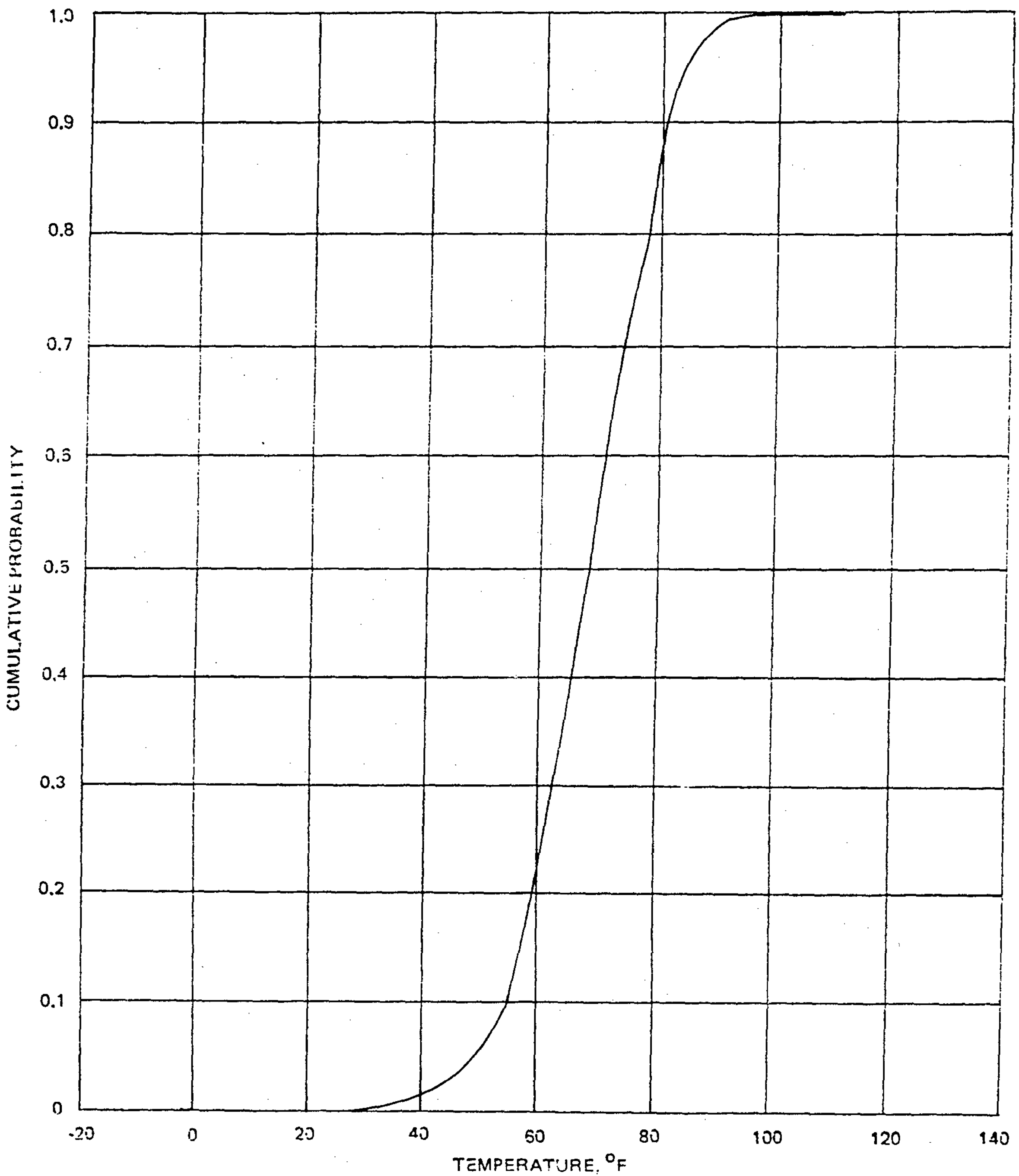

FIGURE 41. Cumulative Probability of Occurrence, AD All Data Combined.

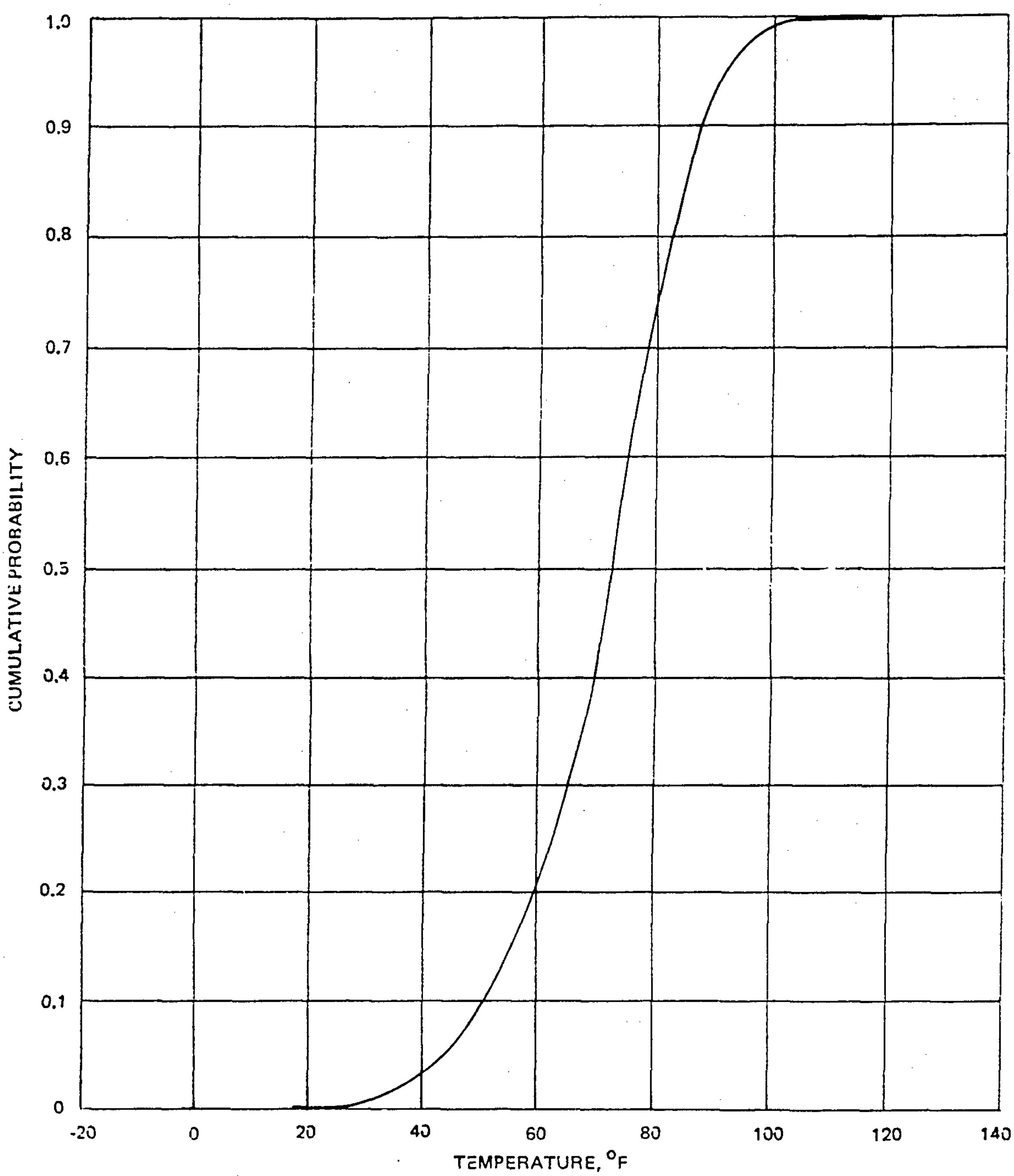

FIGURE 42. All Ships Upper Decks Data Combined.

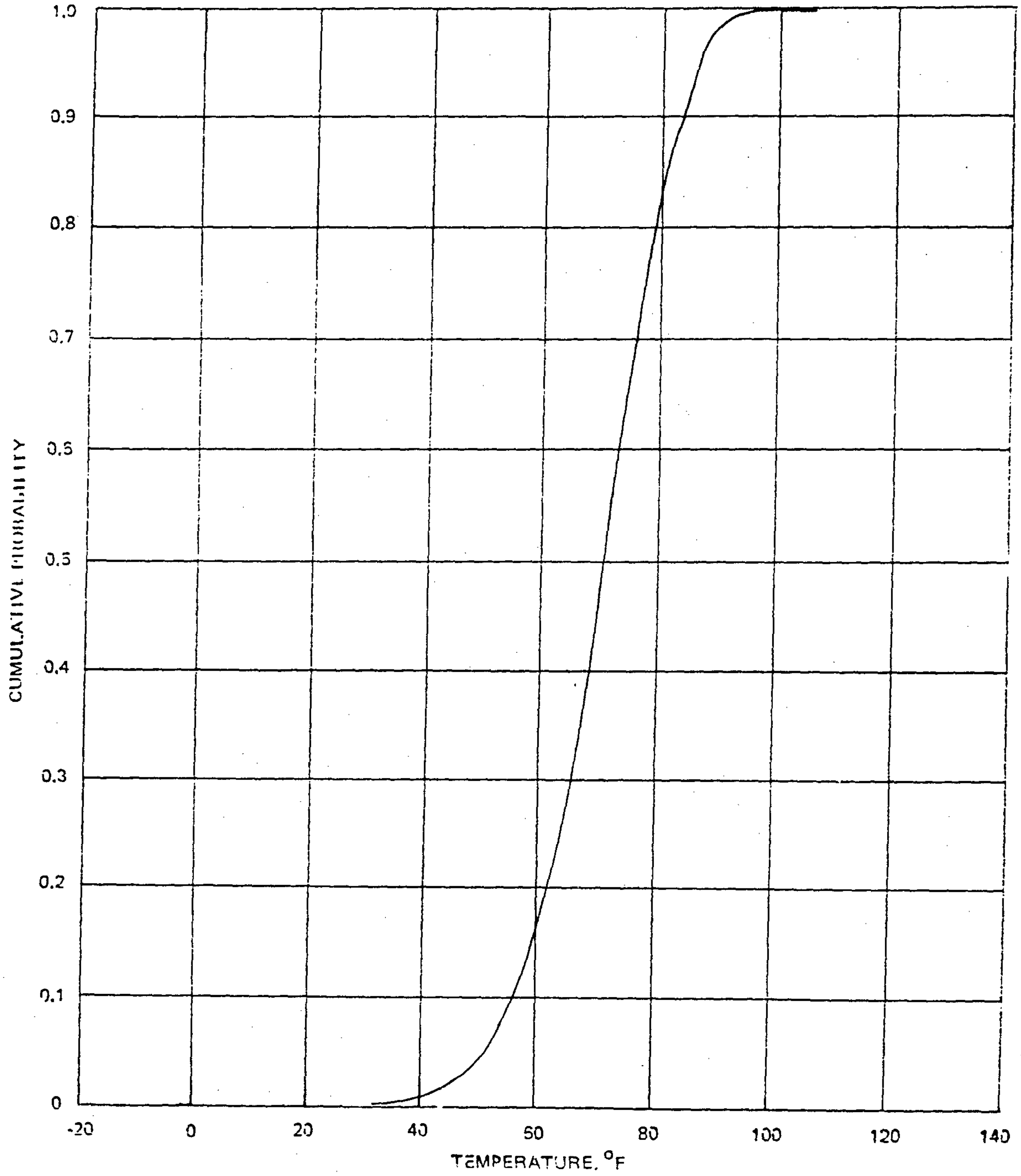

FIGURE 43. All Ships Lower Decks Data Combined.

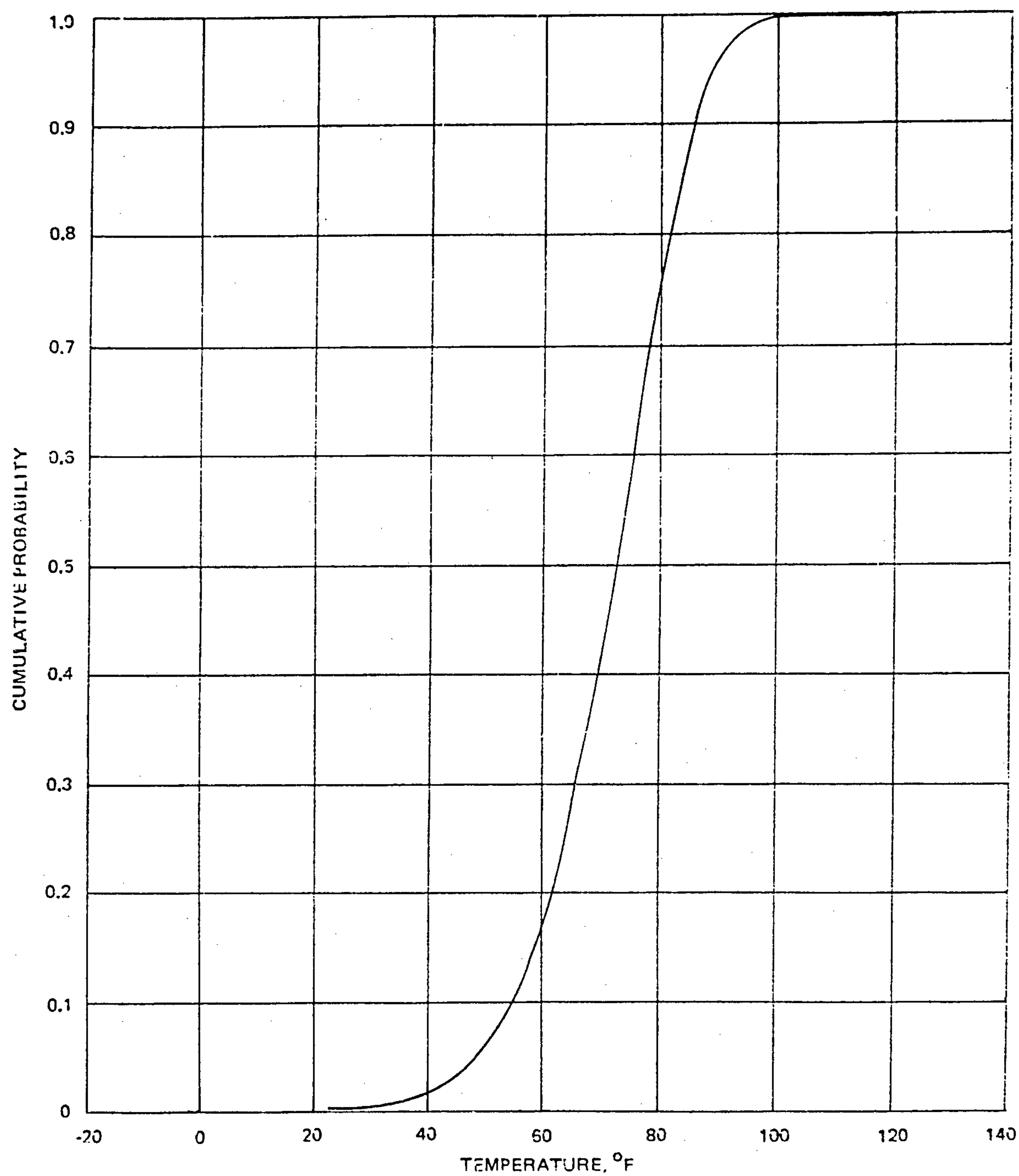

FIGURE 44. All Decks/All Ships Data.

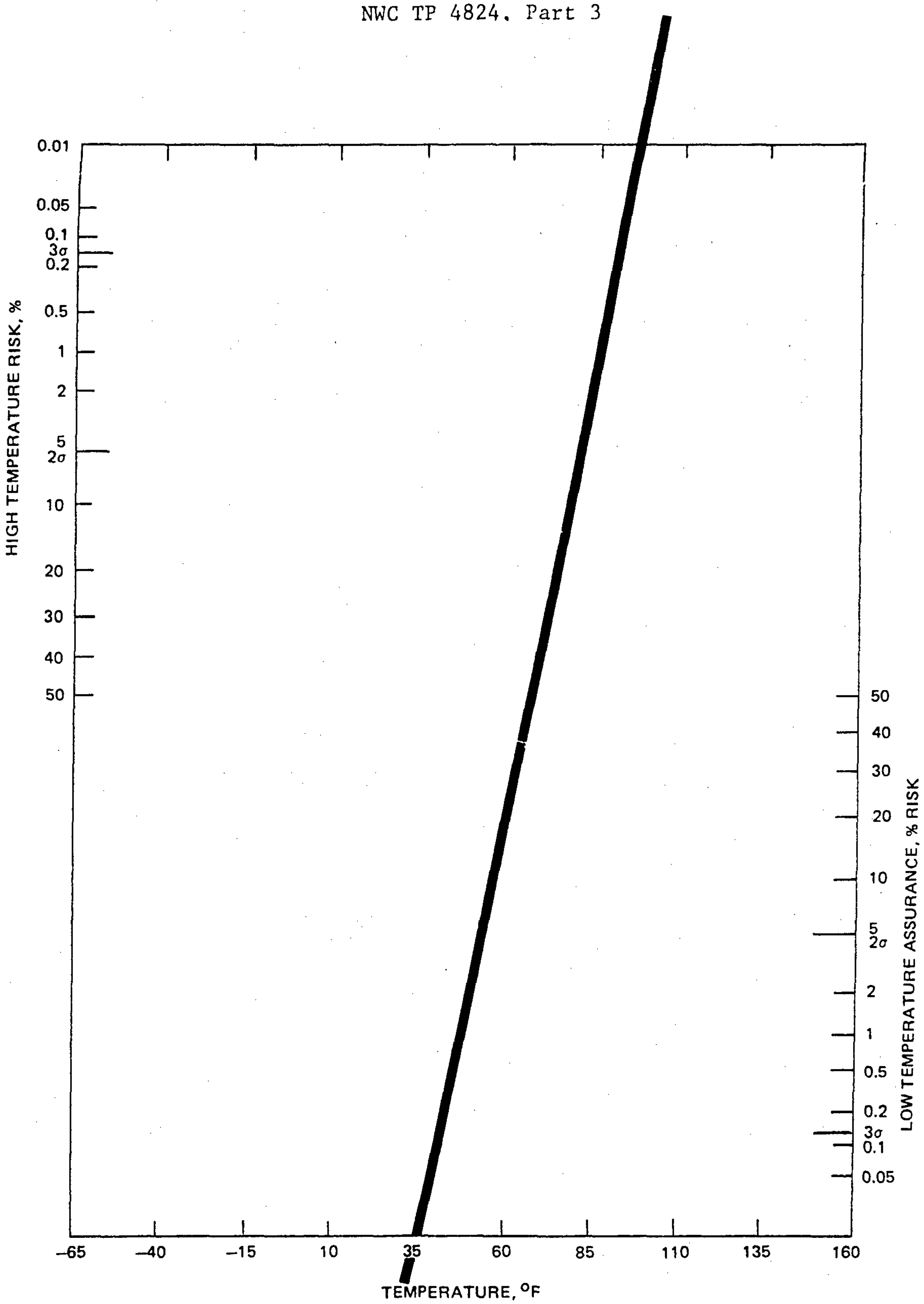

FIGURE 45. Gaussian Interpretation of All Decks/All Ships Composite.

Appendix A

DATA HANDLING AND DEFINITIONS

DATA HANDLING

Temperature data from logbooks, monthly cards, and daily sheets are keypunched in formats as shown in Figure A-1 and the flow of data handling is shown in Figure A-2.

The keypunched temperature data cards are presorted per ship identification, year of the data, and deck level of the compartment or magazine from which the temperature data were taken.

The data cards are prepared as input to the TTAPE program which reads the input and writes the temperature data onto a digital magnetic tape (TTAPE Raw Data) and also prints out a set of tabulations showing the files written on this tape via the UNIVAC 1110 computer. Data from each deck level represent a file, and a sample of the tabulation is shown in Figure A-3. All manipulations and reductions of the raw temperature data are done using the tape TTAPE.

Program TTEMP is then prepared with TTAPE as input, and via the computer it sorts and counts the minimum and maximum daily temperature data into stalls of temperature data from -20° to 120°F at a 1-degree increment. This program outputs the temperature frequency data on punched cards and tabulations as shown in Figure A-4.

The temperature frequency data cards are then checked for obvious bad data points, which are eliminated prior to the data cards being prepared as input to the CTAPE program or FCON program.

When the CTAPE program option is used, the temperature frequency card data are written on a digital magnetic tape (CTAPE Frequency Data) and a list of files of CTAPE is printed out via the computer showing what data (i.e., ship hull number, level, year of data, etc.) were written on which file of CTAPE. The CTAPE program option is used when obtaining temperature frequency data which are summed or consolidated over many levels, many ships, and many years, such that manipulation of the tape input is more efficient and flexible in the computer usage than the handling of voluminous card input.

Program CCON is then prepared for the computer run using the magnetic tape CTAPE as input to compute the consolidated temperature frequency data. The computed data are similarly punched out on cards and printed out in tabulations as the TTEMP program.

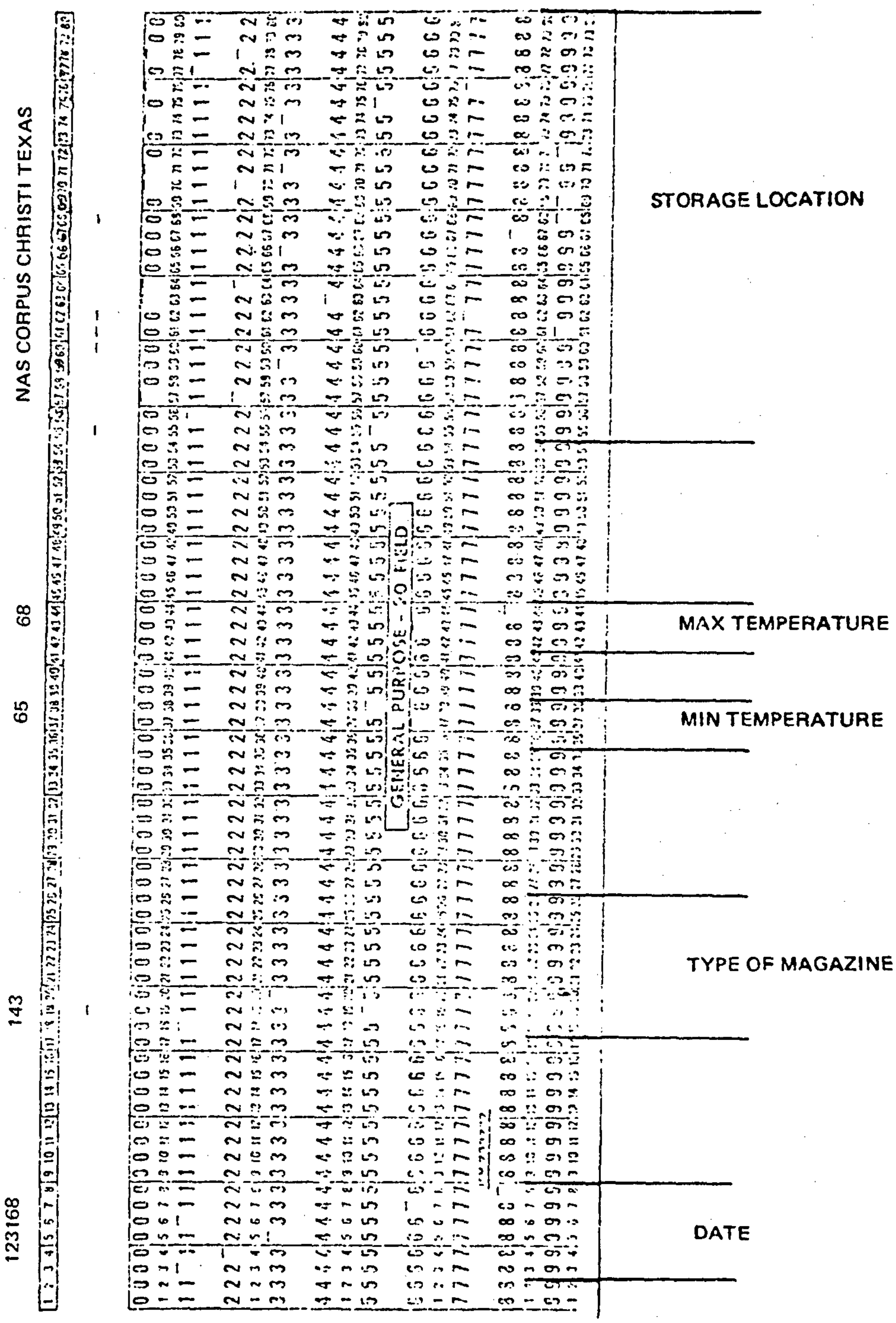

FIGURE A-1. Sample Input Card With Data Fields.

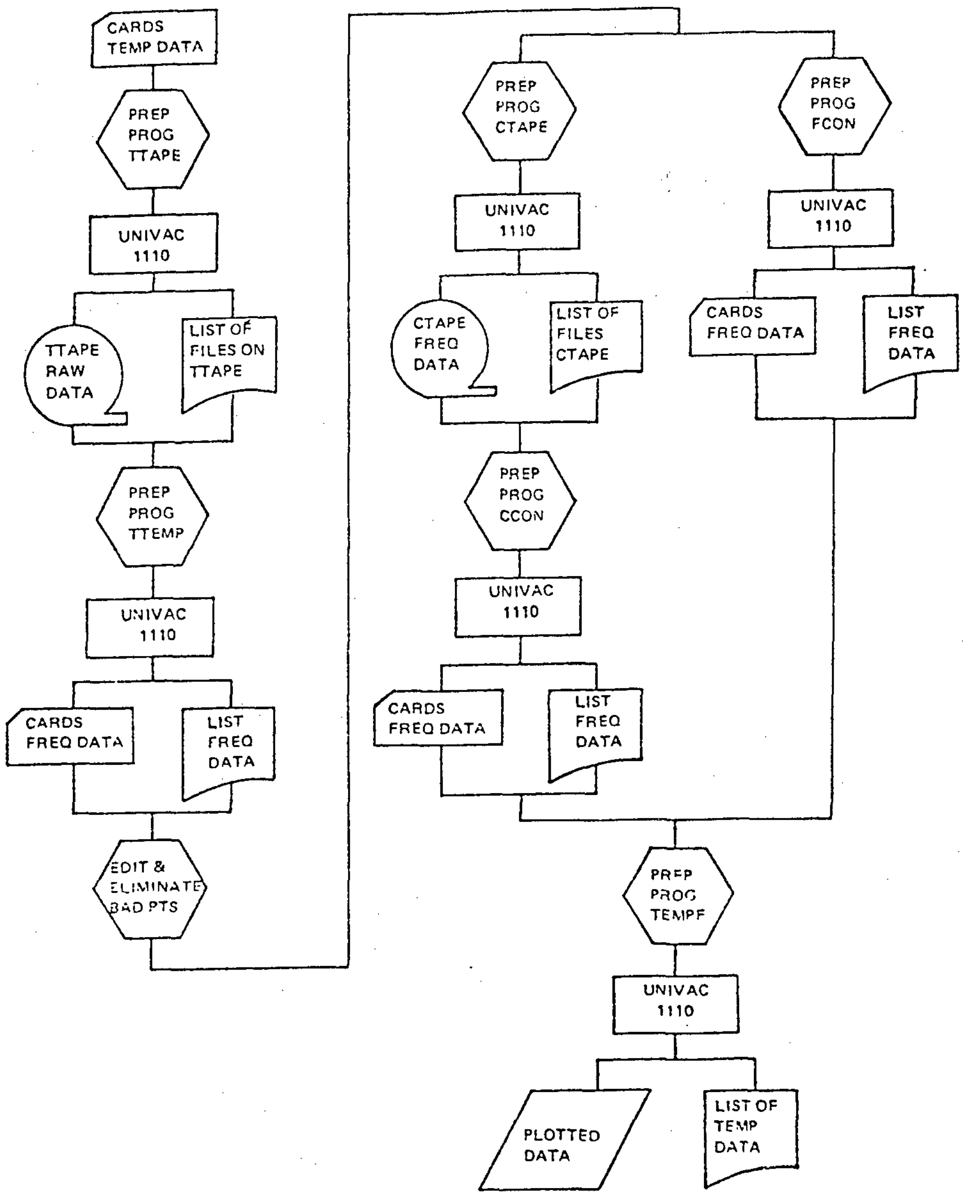

FIGURE A-2. Data Handling Flow.

FILE NO.	LEVEL	HULL NO.	DATA PTS	YEAR	DATE OF RUN
17	IGLOO	S WASHINGTON	212	66	C7/24/79
18	ABVNGD	S WASHINGTON	115	66	07/24/79
19	IGLOO	S WASHINGTON	109	67	07/24/79
20	ABVNGD	S WASHINGTON	44	67	07/24/79

FIGURE A-3. Sample Tabulation.

The consolidated temperature frequency data cards from program CCON are then prepared as input to program TEMPF. Program TEMPF takes this input and computes the cumulative frequency and cumulative probability data of the consolidated temperature data for both separate and combined minimum and maximum temperatures. The program outputs plotted and tabulated data, as shown in Figure A-5.

FCON program option is used when the temperature frequency data cards are relatively small in volume and the consolidation of the data is limited. The program then outputs the consolidated temperature frequency data cards and a set of tabulations listing the condolidated temperature frequency data.

The output cards from program FCON are prepared as input to program TEMPF to yield cumulative frequency and cumulative probability data of the consolidated temperature data as discussed above.

All plotted data presented in this publication are augmented with tabulated data and are available in the permanent file of the NWC Ordnance Test and Evaluation Division.

DEFINITIONS OF DATA

Data presented in Figure A-4 are defined in the following:

TAPE NO. is the tape number identifying the tape that temperature data are written on.

File NO. is the file number of the tape that the data are written on.

IDENTIFICATION gives the deck level of the ship from which the data were obtained, the year of the data, the hull number of the ship, and the date of the tape.

MIN column gives the daily minimum temperature data.

MAX column gives the daily maximum temperature data.

TMIN TOTAL DATA PTS gives the total number of daily minimum temperature data available on this file.

TMAX TOTAL DATA PTS gives the total number of daily maximum temperature data available on this file.

NO. OF BAD PTS gives the number of daily minimum or maximum temperature data that were lower than -20°F or greater than 120°F.

NO. OF DATA PTS USED gives the number of daily minimum or maximum temperature data that were used in the compilation of the frequency data.

FREQUENCY OF TMIN SUB I gives the frequencies of the daily minimum temperature data from -20° to 120°F at 1-degree intervals and is denoted $N_{t_{min_i}}$.

FREQUENCY OF TMAX SUB I gives the frequencies of the daily maximum temperature data from -20° to 120°F at 1-degree intervals and is denoted $N_{t_{max_i}}$.

FREQUENCY OF (TMAX AND TMIN) SUB I gives the frequencies of the daily minimum and maximum, combined, temperature data from -20° to 120°F at 1-degree intervals and is denoted $N(t_{min_i}$ and $t_{max_i})$.

Data presented in Figure A-5 are defined in the following:

CUMULATIVE FREQUENCY UP TO TMIN SUB I gives the cumulative frequencies of the daily minimum temperature from -20°F up to minimum temperature of interest and is denoted $NCF_{t_{min_i}}$.

$NFC_{t_{min_i}} = \sum_j^k N_{t_{min_i}}$, where $N_{t_{min_j}}$ is the frequency of -20°F temperature and $N_{t_{min_k}}$ is the frequency of temperature of interest.

CUMULATIVE FREQUENCY UP TO TMAX SUB I is denoted $NCF_{t_{max_i}}$ and is defined as follows:

$$NCF_{t_{max_i}} = \sum_j^k N_{(t_{min_i} \text{ and } t_{max_i})}$$

PROBABILITY OF TMIN SUB I is denoted $P(t_{max_i})$ and is defined as follows:

$$P(t_{min_i}) = \frac{N_{t_{min_i}}}{N_{t_{min_{total}}}}$$, where $N_{t_{min_{total}}}$ is the total number of

daily minimum temperature data used.

PROBABILITY OF TMAX SUB I is denoted $P(t_{max_i})$ and is defined as follows:

$$P(t_{max_i}) = \frac{N_{t_{max_i}}}{N_{t_{max_{total}}}}$$

PROBABILITY OF (TMIN AND TMAX) SUB I is denoted $P(t_{min_i} \text{ and } t_{max_i})$ and is defined as follows:

$$P(t_{min_i} \text{ and } t_{max_i}) = \frac{N(t_{min_i} \text{ and } t_{max_i})}{N_{t_{min_{total}}} + N_{t_{max_{total}}}}$$

CUMULATIVE PROBABILITY UP TO TMIN SUB I is denoted $Pc(t_{min_i})$ and gives the cumulative probabilities of the daily minimum temperature from -20°F up to minimum temperature of interest. It is defined as follows:

$$Pc(t_{min_i}) = \sum_{j}^{k} \frac{N_{t_{min_i}}}{N_{t_{min_{total}}}}$$

CUMULATIVE PROBABILITY UP TO TMAX SUB I is denoted $Pc(t_{max_i})$ and is defined as follows:

$$Pc(t_{max_i}) = \sum_{j}^{k} \frac{N_{t_{max_i}}}{N_{t_{max_{total}}}}$$

CUMULATIVE PROBABILITY UP TO (TMIN AND TMAX) SUB I is denoted

$$Pc(t_{min_i} \text{ and } t_{max_i}) = \sum_{j}^{k} \frac{N(t_{min_i} \text{ and } t_{max_i})}{N_{t_{min_{total}}} + N_{t_{max_{total}}}}$$

TAPE NO.: 7201 FILE NO.: 17 IDENTIFICATION: LEVEL IGLOO YR 66 S WASHINGTON ON TAPE 07/24/79

MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
40	48	44	48	35	42	40	42	40	45	36	42	40	48	40	46	38	46	41	45
42	47	41	45	39	47	39	45	40	47	38	45	37	47	40	44	46	47	41	45
37	44	40	43	42	46	40	44	46	47	36	44	42	50	40	45	37	50	39	47
40	51	42	44	39	53	36	51	41	49	40	47	35	51	39	53	41	50	40	45
37	50	42	46	48	50	40	47	45	52	36	50	46	50	38	45	40	60	47	55
45	55	43	51	40	60	45	51	48	57	43	56	45	55	44	50	47	55	45	51
46	47	47	48	50	50	47	48	40	57	44	51	47	56	44	51	46	62	45	61
48	55	50	66	56	65	52	57	46	62	47	52	51	63	51	56	54	66	50	58
50	63	50	55	55	63	55	61	50	61	50	54	55	65	55	60	55	66	50	58
65	76	55	60	58	65	55	60	58	63	61	69	58	63	60	72	56	63	68	70
58	63	58	65	56	62	59	67	56	61	56	68	57	64	60	72	57	64	56	72
60	65	62	65	61	65	62	65	60	66	63	73	58	66	60	75	65	70	60	68
63	75	59	73	60	76	65	70	64	65	67	68	61	63	64	66	59	62	65	65
62	63	62	63	65	67	60	68	62	76	59	69	57	79	65	70	60	65	64	75
60	68	63	75	57	70	56	64	60	65	61	68	58	62	56	66	47	65	60	60
65	67	60	60	60	62	63	64	55	56	62	63	58	60	56	59	60	61	54	63
58	72	55	66	50	70	60	72	50	55	50	55	50	76	52	61	50	51	45	60
54	58	50	57	51	56	50	58	54	56	54	59	51	56	50	54	48	57	48	54
51	55	48	53	50	52	48	52	45	45	50	51	46	50	48	54	47	50	41	52
50	51	47	51	48	51	46	49	43	47	48	50	42	48	46	51	45	49	39	50
49	50	44	49	48	66	38	48	47	48	45	51	43	48	45	50	45	50	40	50
46	50	43	44																

TMIN TOTAL DATA PTS: 212 NO. OF BAD PTS: 0 NO. OF DATA PTS USED: 212

TMAX TOTAL DATA PTS: 212 NO. OF BAD PTS: 0 NO. OF DATA PTS USED: 212

FIGURE A-4. Program Outputs.

TAPE NO.: 7201 FILE NO.: 17 IDENTIFICATION: LEVEL IGLOO YR 66 S WASHINGTON ON TAPE 07/24/79

FREQUENCY OF (TMIN AND TMAX) SUB I

-20 DEG:	0	10 DEG:	0	40 DEG:	18	70 DEG:	6	100 DEG:	0
-19 DEG:	0	11 DEG:	0	41 DEG:	6	71 DEG:	0	101 DEG:	0
-18 DEG:	0	12 DEG:	0	42 DEG:	9	72 DEG:	5	102 DEG:	0
-17 DEG:	0	13 DEG:	0	43 DEG:	6	73 DEG:	2	103 DEG:	0
-16 DEG:	0	14 DEG:	0	44 DEG:	11	74 DEG:	0	104 DEG:	0
-15 DEG:	0	15 DEG:	0	45 DEG:	22	75 DEG:	4	105 DEG:	0
-14 DEG:	0	16 DEG:	0	46 DEG:	14	76 DEG:	4	106 DEG:	0
-13 DEG:	0	17 DEG:	0	47 DEG:	21	77 DEG:	0	107 DEG:	0
-12 DEG:	0	18 DEG:	0	48 DEG:	20	78 DEG:	0	108 DEG:	0
-11 DEG:	0	19 DEG:	0	49 DEG:	5	79 DEG:	1	109 DEG:	0
-10 DEG:	0	20 DEG:	0	50 DEG:	37	80 DEG:	0	110 DEG:	0
-9 DEG:	0	21 DEG:	0	51 DEG:	20	81 DEG:	0	111 DEG:	0
-8 DEG:	0	22 DEG:	0	52 DEG:	7	82 DEG:	0	112 DEG:	0
-7 DEG:	0	23 DEG:	0	53 DEG:	3	83 DEG:	0	113 DEG:	0
-6 DEG:	0	24 DEG:	0	54 DEG:	9	84 DEG:	0	114 DEG:	0
-5 DEG:	0	25 DEG:	0	55 DEG:	18	85 DEG:	0	115 DEG:	0
-4 DEG:	0	26 DEG:	0	56 DEG:	16	86 DEG:	0	116 DEG:	0
-3 DEG:	0	27 DEG:	0	57 DEG:	9	87 DEG:	0	117 DEG:	0
-2 DEG:	0	28 DEG:	0	58 DEG:	13	88 DEG:	0	118 DEG:	0
-1 DEG:	0	29 DEG:	0	59 DEG:	6	89 DEG:	0	119 DEG:	0
0 DEG:	0	30 DEG:	0	60 DEG:	25	90 DEG:	0	120 DEG:	0
1 DEG:	0	31 DEG:	0	61 DEG:	10	91 DEG:	0		
2 DEG:	0	32 DEG:	0	62 DEG:	12	92 DEG:	0		
3 DEG:	0	33 DEG:	0	63 DEG:	16	93 DEG:	0		
4 DEG:	0	34 DEG:	0	64 DEG:	7	94 DEG:	0		
5 DEG:	0	35 DEG:	2	65 DEG:	20	95 DEG:	0		
6 DEG:	0	36 DEG:	4	66 DEG:	9	96 DEG:	0		
7 DEG:	0	37 DEG:	4	67 DEG:	4	97 DEG:	0		
8 DEG:	0	38 DEG:	4	68 DEG:	7	98 DEG:	0		
9 DEG:	0	39 DEG:	6	69 DEG:	2	99 DEG:	0		

FIGURE A-4. (Contd.)

TAPE NO.: 7201 FILE NO.: 17 IDENTIFICATION: LEVEL IGLOO YR 66 S WASHINGTON ON TAPE 07/24/79

FREQUENCY OF TMAX SUB I

-20 DEG:	0	10 DEG:	0	40 DEG:	0	70 DEG:	6	100 DEG:	0
-19 DEG:	0	11 DEG:	0	41 DEG:	0	71 DEG:	0	101 DEG:	0
-18 DEG:	0	12 DEG:	0	42 DEG:	3	72 DEG:	5	102 DEG:	0
-17 DEG:	0	13 DEG:	0	43 DEG:	1	73 DEG:	2	103 DEG:	0
-16 DEG:	0	14 DEG:	0	44 DEG:	6	74 DEG:	0	104 DEG:	0
-15 DEG:	0	15 DEG:	0	45 DEG:	10	75 DEG:	4	105 DEG:	0
-14 DEG:	0	16 DEG:	0	46 DEG:	4	76 DEG:	4	106 DEG:	0
-13 DEG:	0	17 DEG:	0	47 DEG:	11	77 DEG:	0	107 DEG:	0
-12 DEG:	0	18 DEG:	0	48 DEG:	9	78 DEG:	0	108 DEG:	0
-11 DEG:	0	19 DEG:	0	49 DEG:	4	79 DEG:	1	109 DEG:	0
-10 DEG:	0	20 DEG:	0	50 DEG:	18	80 DEG:	0	110 DEG:	0
-9 DEG:	0	21 DEG:	0	51 DEG:	15	81 DEG:	0	111 DEG:	0
-8 DEG:	0	22 DEG:	0	52 DEG:	5	82 DEG:	0	112 DEG:	0
-7 DEG:	0	23 DEG:	0	53 DEG:	3	83 DEG:	0	113 DEG:	0
-6 DEG:	0	24 DEG:	0	54 DEG:	4	84 DEG:	0	114 DEG:	0
-5 DEG:	0	25 DEG:	0	55 DEG:	9	85 DEG:	0	115 DEG:	0
-4 DEG:	0	26 DEG:	0	56 DEG:	7	86 DEG:	0	116 DEG:	0
-3 DEG:	0	27 DEG:	0	57 DEG:	5	87 DEG:	0	117 DEG:	0
-2 DEG:	0	28 DEG:	0	58 DEG:	4	88 DEG:	0	118 DEG:	0
-1 DEG:	0	29 DEG:	0	59 DEG:	2	89 DEG:	0	119 DEG:	0
0 DEG:	0	30 DEG:	0	60 DEG:	9	90 DEG:	0	120 DEG:	0
1 DEG:	0	31 DEG:	0	61 DEG:	6	91 DEG:	0		
2 DEG:	0	32 DEG:	0	62 DEG:	6	92 DEG:	0		
3 DEG:	0	33 DEG:	0	63 DEG:	12	93 DEG:	0		
4 DEG:	0	34 DEG:	0	64 DEG:	4	94 DEG:	0		
5 DEG:	0	35 DEG:	0	65 DEG:	13	95 DEG:	0		
6 DEG:	0	36 DEG:	0	66 DEG:	9	96 DEG:	0		
7 DEG:	0	37 DEG:	0	67 DEG:	3	97 DEG:	0		
8 DEG:	0	38 DEG:	0	68 DEG:	6	98 DEG:	0		
9 DEG:	0	39 DEG:	0	69 DEG:	2	99 DEG:	0		

FIGURE A-4. (Contd.)

TAPE NO.: 7201 FILE NO.: 17 IDENTIFICATION: LEVEL IGLOO YR 66 S WASHINGTON ON TAPE 07/24/79

FREQUENCY OF TMIN SUB I

-20 DEG:	0	10 DEG:	0	40 DEG:	18	70 DEG:	0	100 DEG:	0
-19 DEG:	0	11 DEG:	0	41 DEG:	6	71 DEG:	0	101 DEG:	0
-18 DEG:	0	12 DEG:	0	42 DEG:	6	72 DEG:	0	102 DEG:	0
-17 DEG:	0	13 DEG:	0	43 DEG:	5	73 DEG:	0	103 DEG:	0
-16 DEG:	0	14 DEG:	0	44 DEG:	5	74 DEG:	0	104 DEG:	0
-15 DEG:	0	15 DEG:	0	45 DEG:	12	75 DEG:	0	105 DEG:	0
-14 DEG:	0	16 DEG:	0	46 DEG:	10	76 DEG:	0	106 DEG:	0
-13 DEG:	0	17 DEG:	0	47 DEG:	10	77 DEG:	0	107 DEG:	0
-12 DEG:	0	18 DEG:	0	48 DEG:	11	78 DEG:	0	108 DEG:	0
-11 DEG:	0	19 DEG:	0	49 DEG:	1	79 DEG:	0	109 DEG:	0
-10 DEG:	0	20 DEG:	0	50 DEG:	19	80 DEG:	0	110 DEG:	0
-9 DEG:	0	21 DEG:	0	51 DEG:	5	81 DEG:	0	111 DEG:	0
-8 DEG:	0	22 DEG:	0	52 DEG:	2	82 DEG:	0	112 DEG:	0
-7 DEG:	0	23 DEG:	0	53 DEG:	0	83 DEG:	0	113 DEG:	0
-6 DEG:	0	24 DEG:	0	54 DEG:	5	84 DEG:	0	114 DEG:	0
-5 DEG:	0	25 DEG:	0	55 DEG:	9	85 DEG:	0	115 DEG:	0
-4 DEG:	0	26 DEG:	0	56 DEG:	9	86 DEG:	0	116 DEG:	0
-3 DEG:	0	27 DEG:	0	57 DEG:	4	87 DEG:	0	117 DEG:	0
-2 DEG:	0	28 DEG:	0	58 DEG:	9	88 DEG:	0	118 DEG:	0
-1 DEG:	0	29 DEG:	0	59 DEG:	4	89 DEG:	0	119 DEG:	0
0 DEG:	0	30 DEG:	0	60 DEG:	16	90 DEG:	0	120 DEG:	0
1 DEG:	0	31 DEG:	0	61 DEG:	4	91 DEG:	0		
2 DEG:	0	32 DEG:	0	62 DEG:	6	92 DEG:	0		
3 DEG:	0	33 DEG:	0	63 DEG:	4	93 DEG:	0		
4 DEG:	0	34 DEG:	0	64 DEG:	3	94 DEG:	0		
5 DEG:	0	35 DEG:	2	65 DEG:	7	95 DEG:	0		
6 DEG:	0	36 DEG:	4	66 DEG:	0	96 DEG:	0		
7 DEG:	0	37 DEG:	4	67 DEG:	1	97 DEG:	0		
8 DEG:	0	38 DEG:	4	68 DEG:	1	98 DEG:	0		
9 DEG:	0	39 DEG:	6	69 DEG:	0	99 DEG:	0		

FIGURE A-4. (Contd.)

IGLOOS SEATTLE, WASHINGTON

CUMULATIVE FREQUENCY UP TO (TMIN AND TMAX) SUB I

-20 DEG:	0	10 DEG:	0	40 DEG:	49	70 DEG:	622	100 DEG:	642
-19 DEG:	0	11 DEG:	0	41 DEG:	61	71 DEG:	622	101 DEG:	642
-18 DEG:	0	12 DEG:	0	42 DEG:	78	72 DEG:	628	102 DEG:	642
-17 DEG:	0	13 DEG:	0	43 DEG:	111	73 DEG:	630	103 DEG:	642
-16 DEG:	0	14 DEG:	0	44 DEG:	139	74 DEG:	630	104 DEG:	642
-15 DEG:	0	15 DEG:	0	45 DEG:	178	75 DEG:	635	105 DEG:	642
-14 DEG:	0	16 DEG:	0	46 DEG:	210	76 DEG:	640	106 DEG:	642
-13 DEG:	0	17 DEG:	0	47 DEG:	240	77 DEG:	640	107 DEG:	642
-12 DEG:	0	18 DEG:	0	48 DEG:	263	78 DEG:	640	108 DEG:	642
-11 DEG:	0	19 DEG:	0	49 DEG:	273	79 DEG:	642	109 DEG:	642
-10 DEG:	0	20 DEG:	0	50 DEG:	319	80 DEG:	642	110 DEG:	642
-9 DEG:	0	21 DEG:	0	51 DEG:	346	81 DEG:	642	111 DEG:	642
-8 DEG:	0	22 DEG:	0	52 DEG:	358	82 DEG:	642	112 DEG:	642
-7 DEG:	0	23 DEG:	0	53 DEG:	368	83 DEG:	642	113 DEG:	642
-6 DEG:	0	24 DEG:	0	54 DEG:	383	84 DEG:	642	114 DEG:	642
-5 DEG:	0	25 DEG:	0	55 DEG:	408	85 DEG:	642	115 DEG:	642
-4 DEG:	0	26 DEG:	0	56 DEG:	430	86 DEG:	642	116 DEG:	642
-3 DEG:	0	27 DEG:	0	57 DEG:	446	87 DEG:	642	117 DEG:	642
-2 DEG:	0	28 DEG:	0	58 DEG:	465	88 DEG:	642	118 DEG:	642
-1 DEG:	0	29 DEG:	0	59 DEG:	472	89 DEG:	642	119 DEG:	642
0 DEG:	0	30 DEG:	0	60 DEG:	503	90 DEG:	642	120 DEG:	642
1 DEG:	0	31 DEG:	1	61 DEG:	513	91 DEG:	642		
2 DEG:	0	32 DEG:	2	62 DEG:	531	92 DEG:	642		
3 DEG:	0	33 DEG:	2	63 DEG:	547	93 DEG:	642		
4 DEG:	0	34 DEG:	2	64 DEG:	561	94 DEG:	642		
5 DEG:	0	35 DEG:	4	65 DEG:	584	95 DEG:	642		
6 DEG:	0	36 DEG:	8	66 DEG:	596	96 DEG:	642		
7 DEG:	0	37 DEG:	13	67 DEG:	601	97 DEG:	642		
8 DEG:	0	38 DEG:	17	68 DEG:	612	98 DEG:	642		
9 DEG:	0	39 DEG:	23	69 DEG:	615	99 DEG:	642		

FIGURE A-5. Sample Plots.

IGLOOS SEATTLE, WASHINGTON

CUMULATIVE PROBABILITY UP TO (TMIN AND TMAX) SUB I

-20 DEG:	.0000	10 DEG:	.0000	40 DEG:	.0763	70 DEG:	.9688	100 DEG:	1.0000
-19 DEG:	.0000	11 DEG:	.0000	41 DEG:	.0950	71 DEG:	.9688	101 DEG:	1.0000
-18 DEG:	.0000	12 DEG:	.0000	42 DEG:	.1215	72 DEG:	.9782	102 DEG:	1.0000
-17 DEG:	.0000	13 DEG:	.0000	43 DEG:	.1729	73 DEG:	.9813	103 DEG:	1.0000
-16 DEG:	.0000	14 DEG:	.0000	44 DEG:	.2165	74 DEG:	.9813	104 DEG:	1.0000
-15 DEG:	.0000	15 DEG:	.0000	45 DEG:	.2773	75 DEG:	.9891	105 DEG:	1.0000
-14 DEG:	.0000	16 DEG:	.0000	46 DEG:	.3271	76 DEG:	.9969	106 DEG:	1.0000
-13 DEG:	.0000	17 DEG:	.0000	47 DEG:	.3738	77 DEG:	.9969	107 DEG:	1.0000
-12 DEG:	.0000	18 DEG:	.0000	48 DEG:	.4097	78 DEG:	.9969	108 DEG:	1.0000
-11 DEG:	.0000	19 DEG:	.0000	49 DEG:	.4252	79 DEG:	1.0000	109 DEG:	1.0000
-10 DEG:	.0000	20 DEG:	.0000	50 DEG:	.4969	80 DEG:	1.0000	110 DEG:	1.0000
-9 DEG:	.0000	21 DEG:	.0000	51 DEG:	.5389	81 DEG:	1.0000	111 DEG:	1.0000
-8 DEG:	.0000	22 DEG:	.0000	52 DEG:	.5576	82 DEG:	1.0000	112 DEG:	1.0000
-7 DEG:	.0000	23 DEG:	.0000	53 DEG:	.5732	83 DEG:	1.0000	113 DEG:	1.0000
-6 DEG:	.0000	24 DEG:	.0000	54 DEG:	.5966	84 DEG:	1.0000	114 DEG:	1.0000
-5 DEG:	.0000	25 DEG:	.0000	55 DEG:	.6355	85 DEG:	1.0000	115 DEG:	1.0000
-4 DEG:	.0000	26 DEG:	.0000	56 DEG:	.6698	86 DEG:	1.0000	116 DEG:	1.0000
-3 DEG:	.0000	27 DEG:	.0000	57 DEG:	.6947	87 DEG:	1.0000	117 DEG:	1.0000
-2 DEG:	.0000	28 DEG:	.0000	58 DEG:	.7243	88 DEG:	1.0000	118 DEG:	1.0000
-1 DEG:	.0000	29 DEG:	.0000	59 DEG:	.7352	89 DEG:	1.0000	119 DEG:	1.0000
0 DEG:	.0000	30 DEG:	.0000	60 DEG:	.7835	90 DEG:	1.0000	120 DEG:	1.0000
1 DEG:	.0000	31 DEG:	.0016	61 DEG:	.7991	91 DEG:	1.0000		
2 DEG:	.0000	32 DEG:	.0031	62 DEG:	.8271	92 DEG:	1.0000		
3 DEG:	.0000	33 DEG:	.0031	63 DEG:	.8520	93 DEG:	1.0000		
4 DEG:	.0000	34 DEG:	.0031	64 DEG:	.8738	94 DEG:	1.0000		
5 DEG:	.0000	35 DEG:	.0062	65 DEG:	.9097	95 DEG:	1.0000		
6 DEG:	.0000	36 DEG:	.0125	66 DEG:	.9283	96 DEG:	1.0000		
7 DEG:	.0000	37 DEG:	.0202	67 DEG:	.9361	97 DEG:	1.0000		
8 DEG:	.0000	38 DEG:	.0265	68 DEG:	.9533	98 DEG:	1.0000		
9 DEG:	.0000	39 DEG:	.0358	69 DEG:	.9579	99 DEG:	1.0000		

FIGURE A-5. (Contd.)

IGLOOS SEATTLE, WASHINGTON

PROBABILITY OF (THIN AND THAX) SUB I

-20 DEG: .0000	10 DEG: .0000	40 DEG: .0405	70 DEG: .0109	100 DEG: .0000
-19 DEG: .0000	11 DEG: .0000	41 DEG: .0187	71 DEG: .0000	101 DEG: .0000
-18 DEG: .0000	12 DEG: .0000	42 DEG: .0265	72 DEG: .0093	102 DEG: .0000
-17 DEG: .0000	13 DEG: .0000	43 DEG: .0514	73 DEG: .0031	103 DEG: .0000
-16 DEG: .0000	14 DEG: .0000	44 DEG: .0436	74 DEG: .0000	104 DEG: .0000
-15 DEG: .0000	15 DEG: .0000	45 DEG: .0607	75 DEG: .0078	105 DEG: .0000
-14 DEG: .0000	16 DEG: .0000	46 DEG: .0498	76 DEG: .0078	106 DEG: .0000
-13 DEG: .0000	17 DEG: .0000	47 DEG: .0467	77 DEG: .0000	107 DEG: .0000
-12 DEG: .0000	18 DEG: .0000	48 DEG: .0358	78 DEG: .0000	108 DEG: .0000
-11 DEG: .0000	19 DEG: .0000	49 DEG: .0156	79 DEG: .0031	109 DEG: .0000
-10 DEG: .0000	20 DEG: .0000	50 DEG: .0717	80 DEG: .0000	110 DEG: .0000
-9 DEG: .0000	21 DEG: .0000	51 DEG: .0421	81 DEG: .0000	111 DEG: .0000
-8 DEG: .0000	22 DEG: .0000	52 DEG: .0187	82 DEG: .0000	112 DEG: .0000
-7 DEG: .0000	23 DEG: .0000	53 DEG: .0156	83 DEG: .0000	113 DEG: .0000
-6 DEG: .0000	24 DEG: .0000	54 DEG: .0234	84 DEG: .0000	114 DEG: .0000
-5 DEG: .0000	25 DEG: .0000	55 DEG: .0389	85 DEG: .0000	115 DEG: .0000
-4 DEG: .0000	26 DEG: .0000	56 DEG: .0343	86 DEG: .0000	116 DEG: .0000
-3 DEG: .0000	27 DEG: .0000	57 DEG: .0249	87 DEG: .0000	117 DEG: .0000
-2 DEG: .0000	28 DEG: .0000	58 DEG: .0296	88 DEG: .0000	118 DEG: .0000
-1 DEG: .0000	29 DEG: .0000	59 DEG: .0109	89 DEG: .0000	119 DEG: .0000
0 DEG: .0000	30 DEG: .0000	60 DEG: .0483	90 DEG: .0000	120 DEG: .0000
1 DEG: .0000	31 DEG: .0016	61 DEG: .0156	91 DEG: .0000	
2 DEG: .0000	32 DEG: .0016	62 DEG: .0280	92 DEG: .0000	
3 DEG: .0000	33 DEG: .0000	63 DEG: .0249	93 DEG: .0000	
4 DEG: .0000	34 DEG: .0000	64 DEG: .0218	94 DEG: .0000	
5 DEG: .0000	35 DEG: .0031	65 DEG: .0358	95 DEG: .0000	
6 DEG: .0000	36 DEG: .0062	66 DEG: .0187	96 DEG: .0000	
7 DEG: .0000	37 DEG: .0078	67 DEG: .0078	97 DEG: .0000	
8 DEG: .0000	38 DEG: .0062	68 DEG: .0171	98 DEG: .0000	
9 DEG: .0000	39 DEG: .0093	69 DEG: .0047	99 DEG: .0000	

FIGURE A-5. (Contd.)

Appendix B

EXPLANATION OF DECK LEVEL AND COMPARTMENT IDENTIFICATION

The various decks of a ship are numbered, using the main deck as a baseline. On all ships except aircraft carriers, the main deck is the upper most deck that runs the length of the ship; on aircraft carriers the hangar deck is the baseline. Below the main deck are the second and third decks, etc. Above the main deck are the 01 level, 02 level, etc.

Two systems of compartment numbering are presently in use, but only the newer system (begun in March 1949) is described here. Compartments are designated by a grouping of various letters and numbers, separated by hyphens. Each compartment is designated by its deck number, frame number (starting at zero at the bow and increasing towards aft), relation to ship's centerline, and usage. An example of this numbering system is 3-75-4-M. The 3 indicates the third deck; the 75 indicates that the forward boundary of the compartment is at frame 75; the 4 indicates that it is on the port of the ship (an odd number would indicate starboard side); and the M indicates that the compartment is used as a magazine. Other compartment designations are A for storage spaces, C for control spaces (areas normally manned, such as CIC communications spaces and the pilot house), E for engineering spaces, F for fuel storage, Q for miscellaneous space (shops, offices, laundry, and galley), T for vertical access trunks, and L for living (berthing) spaces.

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- SEA-62Z2 (1)
- SEA-62Z3 (1)
- SEA-62Z4 (1)
- SEA-62Z5 (1)
- SEA-63Z (1)
- SEA-64 (1)
- SEA-90 (1)
- SEA-90E (1)
- SEA-90T (1)
- SEA-902 (1)
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2 DLA Administrative Support Center (Defense Materiel Specifications and Standards Office)
J. Allen (1)
D. Moses (1)
3 Department of Defense, Explosives Safety Board, Alexandria
3 Deputy Under Secretary of Defense Research and Engineering (Acquisition Policy)
Director, Materiel Acquisition Policy (3E144), J. A. Mattino (1)
Standardization and Support (2A318), Col. T. A. Musson (2)
2 Deputy Under Secretary of Defense Research and Engineering (Research and Advanced Technology)
Director, Engineering Technology, G. R. Makepeace, 3D1089 (1)
R. Thorkildsen (1)
1 Director, Defense Test & Evaluation (Deputy for Test Facilities, W. A. Richardson, 3D1043)
12 Defense Technical Information Center